A RE-ASSESSMENT OF THE ELEMENTS OF AN ECONOMIC STRATEGY FOR THE PROVINCE OF ALBERTA

VOLUME I

CONCLUSIONS AND OBSERVATIONS

PREPARED FOR
THE GOVERNMENT OF THE PROVINCE OF ALBERTA
BY
FOSTER RESEARCH
AND
SRI INTERNATIONAL

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VOLUME I
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VOLUME I

CONCLUSIONS AND OBSERVATIONS

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VOLUME I

PREAMBLE

PREAMBLE

In February 1979, the Government of Alberta, through the Chairman of the Economic Planning Committee of Cabinet, requested that Foster Research undertake a detailed study which would serve as input to a Government re-examination of Alberta's economic strategy for the 1980s. This 1979 request constituted a follow-up to an assessment undertaken in 1971 by Foster Research for the Government of Alberta. The 1971 study was intended to provide an "overview" rather than a comprehensive analysis of the economic future of Alberta, to a horizon year of 1980.

The basic objective of the current study was to prepare a detailed report on Alberta's economic prospects for the decade ahead. The report would assist Provincial policy-makers in assessing future problems and opportunities which likely will face Alberta, and in identifying important areas requiring policy actions in order that the economic goals of the Government may be achieved.

This study has identified:

- the inherent strengths and weaknesses of the Alberta economy;
- areas in which the economy is vulnerable to external forces;
- industries with substantial development potential; and,
- the strategic elements that will be of critical importance in determining the future success of the economy.

At the request of the Government of Alberta, considerable attention was devoted to the economic outlook for those regions of the world and those industries that may have a substantial impact upon the Province. In response to the Government's direction in this regard, that aspect of the activity was sub-contracted to a research organization having expertise in international trade and affairs. SRI International (formerly Stanford Research Institute) of Menlo Park, California, an organization employing over 3,000 persons, was selected to participate in this part of the project through its Center for Economic Policy Research. The Center has been involved in a number of studies relating to world economic developments and issues and worldwide industrial analyses, with particular emphasis on energy, minerals and metals and forest products. The results of SRI's research is contained in Volume II entitled "The Global Economic And Political Environment And Its Impact On Alberta: 1980-1995. SRI and Foster Research have also collaborated on various aspects of the overall project.

As Project Manager, Foster Research also sub-contracted certain other portions of the study to the following:

Organization Or Individual	Nature Of Sub-Contract
McKinnon, Allen & Associates (Western) Ltd., Calgary	An Overview of Agriculture In Alberta
D. M. Brownie & Associates Ltd., Calgary	A Profile Of The Alberta Transportation Sector
Dr. J. R. Brent Ritchie Faculty of Management University of Calgary	Tourism In Alberta - A Strategic Review

The results of their research are presented in their entirety.

Assistance was also obtained from: Dr. R. W. Davenport of R. D. Associates, Los Altos Hills, California, an independent consultant with worldwide experience in the venture capital field and in the organization and management of research and development institutions, industrial parks, and business promotion programs; Dr. Alan J. MacFadyen, Associate Professor, Department of Economics, University of Calgary; and, Mr. George Isherwood, econometrician, who subsequently joined the professional staff of Foster Research.

The scope of the research effort and the depth of the analysis developed for each of the major economic sectors and specific industrial categories varies considerably. The research team directed the majority of its efforts to those key sectors of the economy which are expected to have the most significant impact on the future of Alberta. However, sufficient data were gathered on all sectors to provide an appropriate understanding of the economy as a whole and to enable the research team to construct an econometric model and the data base associated therewith. All equations related to this model have been provided to the Alberta Government and a technical presentation thereof was made to Government representatives. This model has been, and should continue to be, a useful analytical tool for testing the impact of different development scenarios on the outlook for the Provincial economy.

During the conduct of the study, Foster Research and the other consultants involved have received full co-operation from representatives of a number of departments and agencies of the Government. This co-operation is hereby acknowledged and has been greatly appreciated, as have important inputs obtained from the private sector.

The results of the study are contained in three volumes, as follows:

Volume	Title
I	Conclusions And Observations
II	The Global Economic And Political Environment and Its Impact on Alberta: 1980-1995
III (of which there are two parts)	The Alberta Economy

VOLUME I

CONCLUSIONS AND OBSERVATIONS

A RE-ASSESSMENT OF THE ELEMENTS OF AN ECONOMIC STRATEGY FOR THE PROVINCE OF ALBERTA

VOLUME I

CONCLUSIONS AND OBSERVATIONS

A. INTRODUCTION

This Volume was developed jointly by Foster Research and SRI International as an integration of the analyses contained in Volumes II and III of this study, together with the perceptions and qualitative insights gained during its conduct. The material presented herein is policy oriented and should be read in the context of the detailed supporting information combined in the other Volumes. These are briefly summarized in Appendices A and B of this Volume I.

The study findings and conclusions summarized in this Volume include a brief review of the outlook for the total Alberta economy in terms of: provincial gross domestic product; dependence on the energy industries sector; new capital investment; and, population. This review serves as background for the subsequent discussion which focusses on two fundamental issues relating to an economic strategy for the Province.

1. The management of the Province's natural resource strengths including conventional oil and gas, oil sands, agriculture, petrochemicals, coal, forest products and tourism.
2. A long-term strategy aimed at diversifying the Alberta economy.

It is generally recognized and has been quantified in the econometric analysis sections of this study, that Alberta's economy will be closely linked to the further development of Alberta's natural resource strengths in the near, medium and to a significant extent, the long term. As a result, any comprehensive economic strategy should include continuation of the current primary focus on the issues and opportunities available in the natural resource sectors. Current and near term decisions made with respect to those sectors will naturally have a far greater influence on the economy in the next decade than will strategies targeted at more distant horizons.

However, the project team has concluded that the development and early implementation of long range strategies, policies and specific mechanisms for creating new areas of economic activity also will be of critical importance in maintaining the current standard of living enjoyed by Albertans. Such a program requires a significant degree of political courage because, to be successful, it involves major re-deployment of assets and efforts in a time of prosperity, to prepare for a perceived problem well into the future. Difficult as this may be, it is almost inevitable that a major economic penalty will be paid by Alberta if, at this time, it fails to make adequate provision for the future.

This study has addressed the complex problem of setting a provincial economic strategy and in so doing has defined a strategic direction and presented a conceptual framework which the project team believes to be worthy of pursuit.

As background for subsequent discussion of the two fundamental strategic issues, a summary of the outlook for the Provincial economy contained in Chapter V of Volume III is presented in the following section.

B. OUTLOOK FOR THE ALBERTA ECONOMY 1980-1995

1. GROWTH PROJECTIONS

The econometric analysis carried out during this study provides a measure of the future aggregate performance of the Provincial economy for a number of scenarios over the fifteen year period, 1980-1995. The graph illustrated in Figure 1 displays the historical growth of total provincial output (Gross Domestic Product) and defines the range of future forecasts associated with several scenarios generated in this study. The data are presented in constant $ 1971 to provide a measure of real economic growth, excluding inflation. The Reference Case scenario produces an average annual real growth rate of 4.0 per cent for total Provincial Gross Domestic Product (GDP) during the forecast timeframe. Although this is 2.8 percentage points below the average growth rate experienced during the 1965-1980 period, it is nevertheless one full percentage point greater than the 3.0 per cent real average GNP growth rate forecast for the U.S. economy and 0.5 per cent higher than the 3.5 per cent real growth rate projected for Canadian GNP for the same fifteen-year period.

The High growth scenario measures the impact of a maximum development sequence in all sectors of the economy and results in an average growth in provincial GDP of 6.0 per cent for the 10-year period 1980-1990 and 5.25 per cent for the 15-year timeframe 1980-1995.

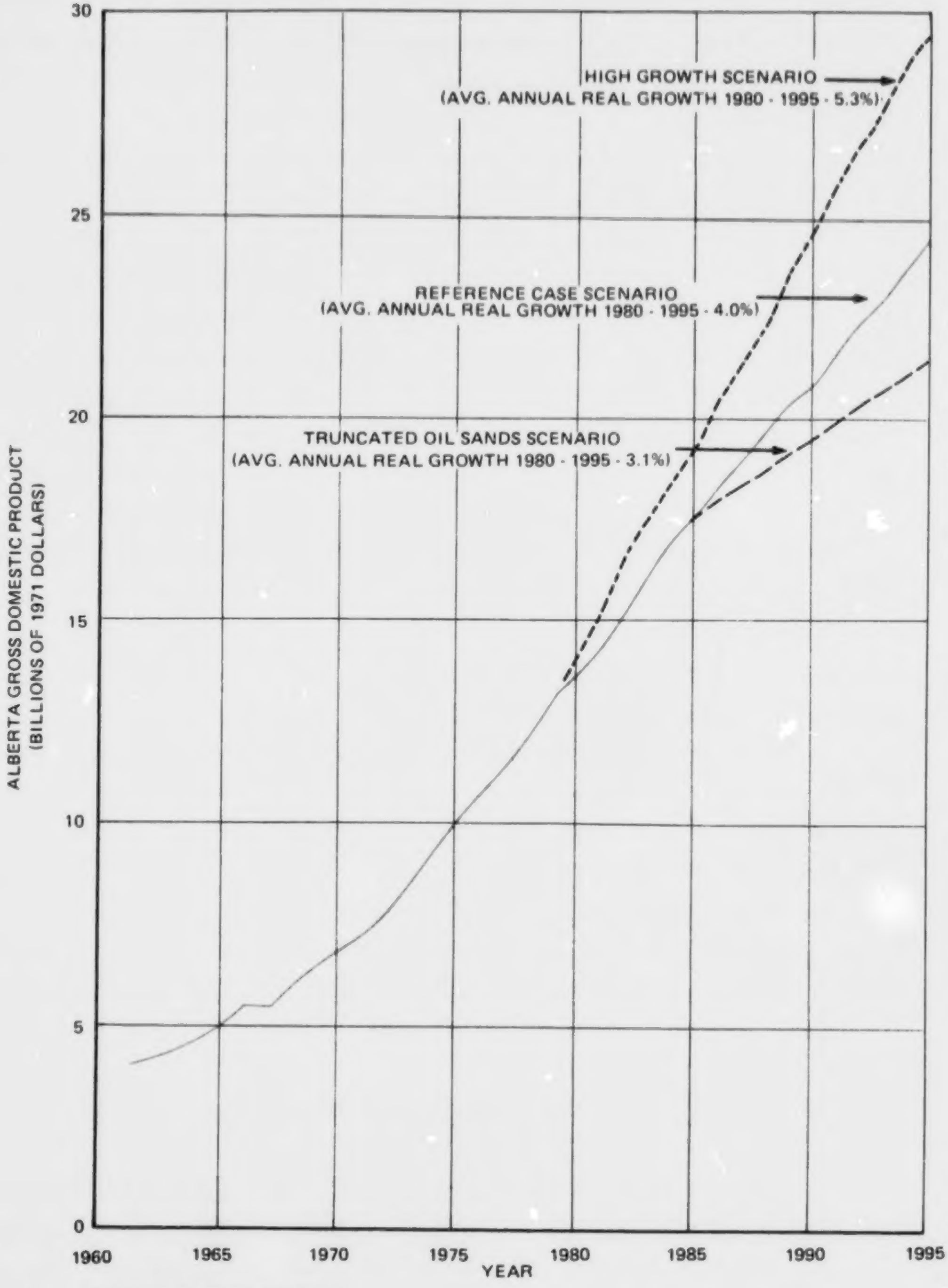
The truncated oil sands development scenario was generated to attempt to quantify the level of economic activity which might occur if oil sands development were to cease after completion of the two major projects currently authorized by the ERCB but not, as yet, commenced. The reduction in the average annual growth in provincial GDP during the decade 1985-1995 to 2.2 per cent per year versus 4.0 per cent in the Reference Case provides some measure of the prospective contribution of oil sands development to the Alberta economy.

2. ENERGY PRICES

Future energy price increases will have a dramatic impact on the overall economic growth rate in the Province. The price sensitivity

PROVINCIAL GROSS DOMESTIC PRODUCT

(HISTORICAL DATA AND PROJECTIONS PRESENTED IN CONSTANT $ 1971)



SOURCE: FOSTER RESEARCH

FIGURE 1

analysis indicates that the average annual real growth rate in Alberta's GDP would be increased from the 4.0 per cent level to approximately 5.0 per cent per year, if world energy supply/demand conditions and Canadian energy pricing policies over the next fifteen years were to translate into a 9.1 per cent real average annual price increase in Alberta light crude (used as the marker) versus the 6.8 per cent real increase used in the Reference Case. Conversely, if the low price scenario (4.1 per cent real increase in Alberta light prices, as the marker) were to prevail, the Alberta GDP growth rate, in real terms, could be slowed to 3.4 per cent per year.

While it is expected that crude oil prices will rise significantly over the next fifteen years, conventional crude oil production will diminish rapidly. Accordingly, Alberta's real growth rate during the latter part of the 15-year time frame and thereafter will depend to a significant degree on the continuation of efforts directed towards diversification of the Provincial economy.

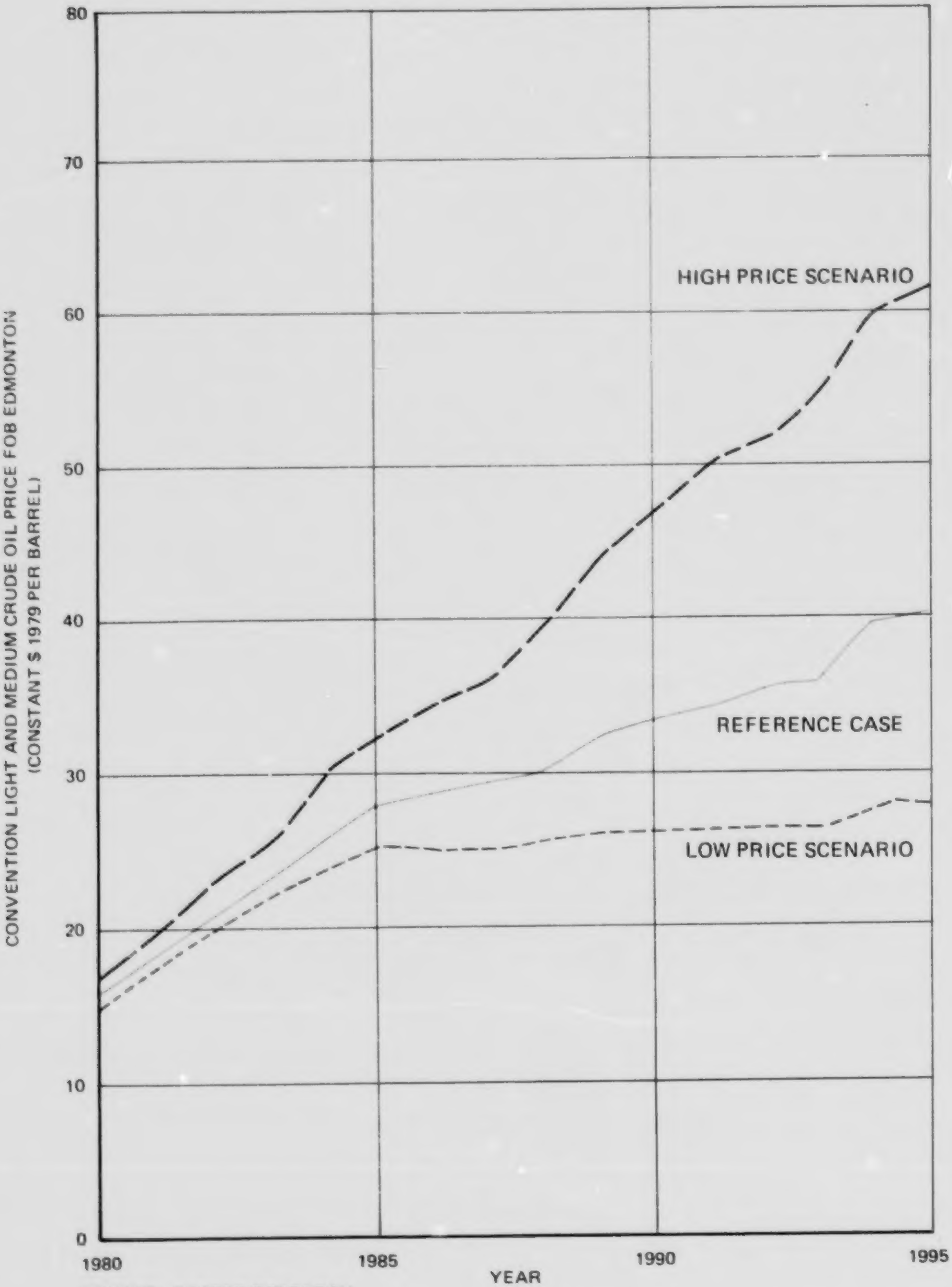
Figure 2 provides a graphical representation of the Reference Case crude oil price projections in constant 1979 dollars, as well as the high and low case pricing scenarios used to develop the sensitivity analysis.

3. DEPENDENCE ON THE ENERGY INDUSTRIES SECTOR

Of much more significance than an examination of absolute growth rate projections is the fact that the econometric analysis indicates the great degree to which the future growth and prosperity of the Alberta economy will be dependent on the value of output of and level of investment in the energy industries sector (defined as conventional oil and gas, coal and other mining, oil sands activity and the royalties accruing to the Provincial Government). This increasing dependence is a result of several factors, including prospective real increases in crude oil and natural gas wellhead prices as well as projected growth in synthetic crude production from the oil sands. The

ALTERNATIVE CRUDE OIL PRICING ASSUMPTIONS

(CONSTANT $ 1979/BBL)



SOURCE: FOSTER RESEARCH

FIGURE 2

ENERGY INDUSTRIES SECTOR GDP AS A PERCENTAGE OF TOTAL PROVINCIAL GDP

(REFERENCE CASE PROJECTION)
EXPRESSED IN NOMINAL DOLLARS

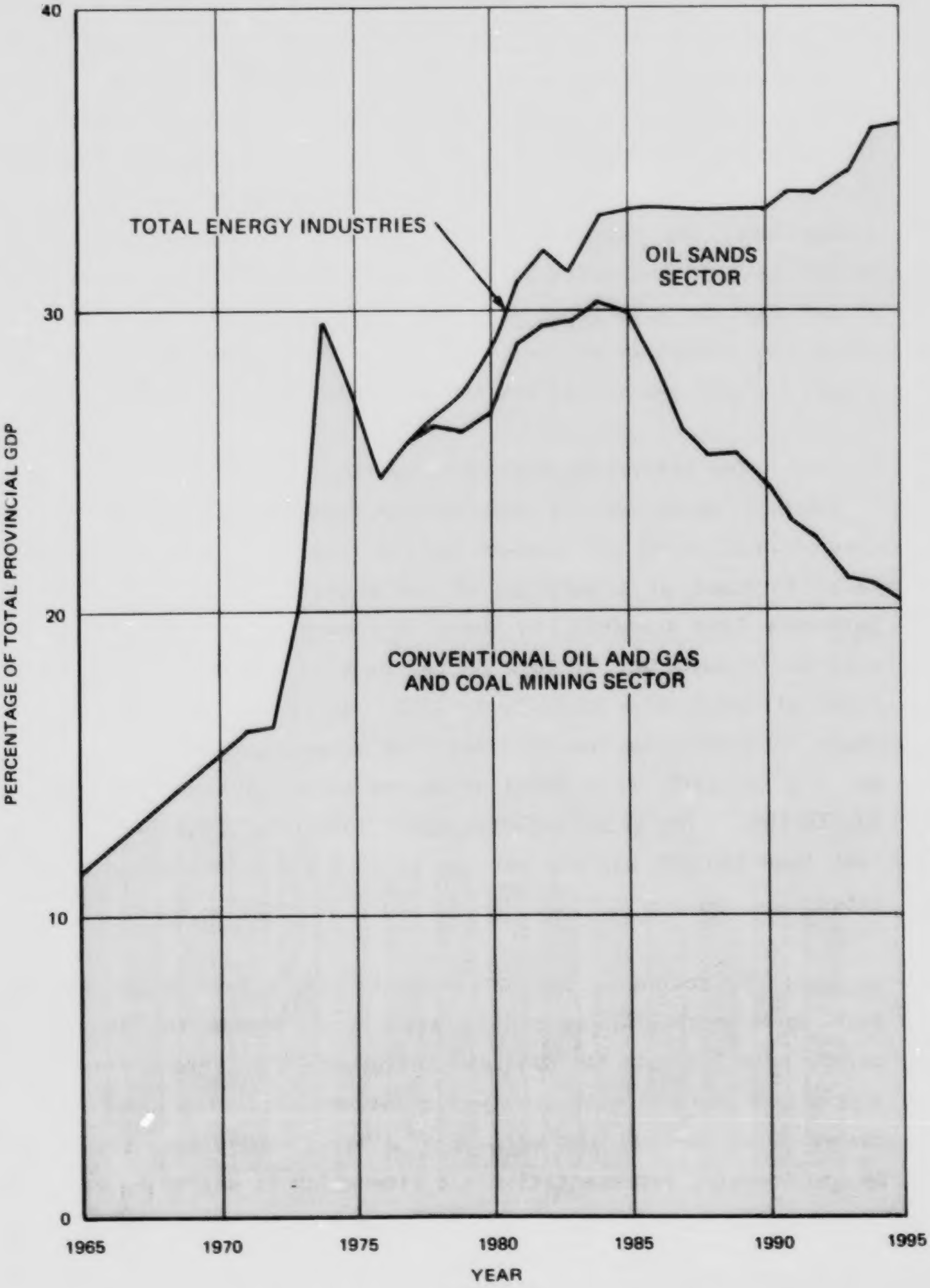


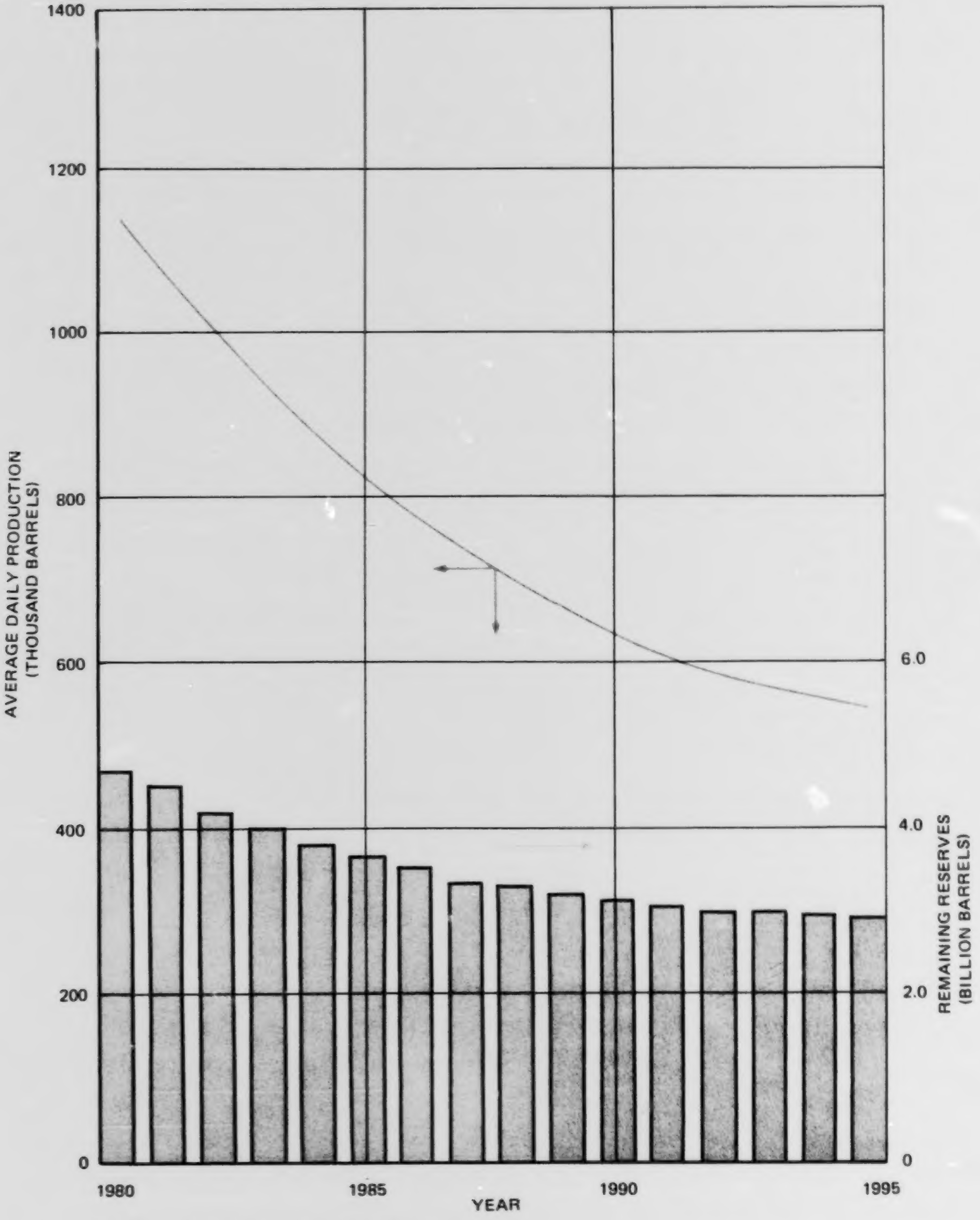
FIGURE 3

graph on Figure 3 traces the percentage contribution to total Provincial GDP represented by the energy industries during the past 15-year period as well as projections for the forecast period 1980-1995. As shown, in nominal dollar terms, the energy industries sector represented approximately 12 per cent of total Provincial output in 1965. Largely as a result of increasing prices since 1973, this increased to the range of 26 to 27 per cent, where it has remained during the past several years. Using the Reference Case scenario assumptions, the energy sector is forecast to represent approximately 33 per cent of the total value of Provincial GDP by the mid-1980s and 36 per cent by 1990 (when measured in nominal dollars). Figure 3 also shows the breakdown of contribution to total GDP between the conventional oil and gas sector and the assumed oil sands development.

The increasing dependence on the energy sector, when measured in nominal terms, occurs despite the dramatic decline anticipated in conventional crude oil production and reserves. The ERCB's "expected case" forecast of production of conventional crude oil, used in the Reference Case scenario, is shown in Figure 4. This illustrates that Alberta is expected to lose 50 per cent of its existing conventional crude all productive capacity by 1995. In specific terms, conventional crude oil production has declined from an average of 1.8 million barrels per day in 1973, to a level of approximately 1.1 million barrels per day in 1980. The ERCB "expected case" forecasts a further reduction to less than 600,000 barrels per day by 1995 and a continuing drop thereafter.

By contrast, the future of Alberta's natural gas resource is much more uncertain, as can be seen by reference to Figure 5. The solid lines indicate the National Energy Board's current view of Alberta supply and demand, with supply limitations occurring about 1995. The dashed lines demonstrate a range of Alberta supply projections as seen by one industry representative - a view which is shared by many.

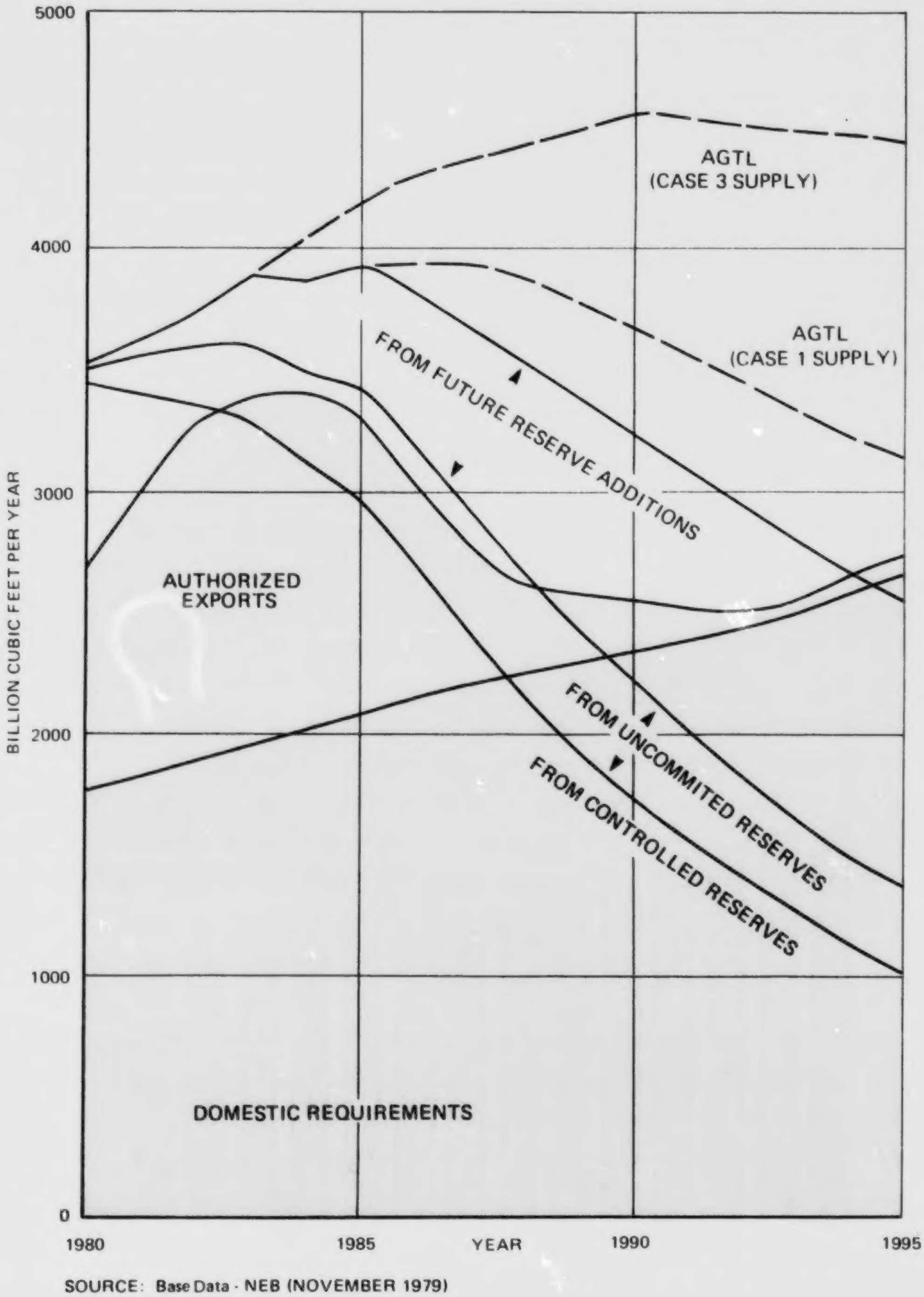
ALBERTA CONVENTIONAL CRUDE OIL PRODUCTION AND REMAINING RESERVES



SOURCE: Base Data - ERCB (OCTOBER 1979)

FIGURE 4

PROJECTED DEMAND FOR AND SUPPLY OF ALBERTA NATURAL GAS



SOURCE: Base Data - NEB (NOVEMBER 1979)

FIGURE 5

4. NEW CAPITAL INVESTMENT

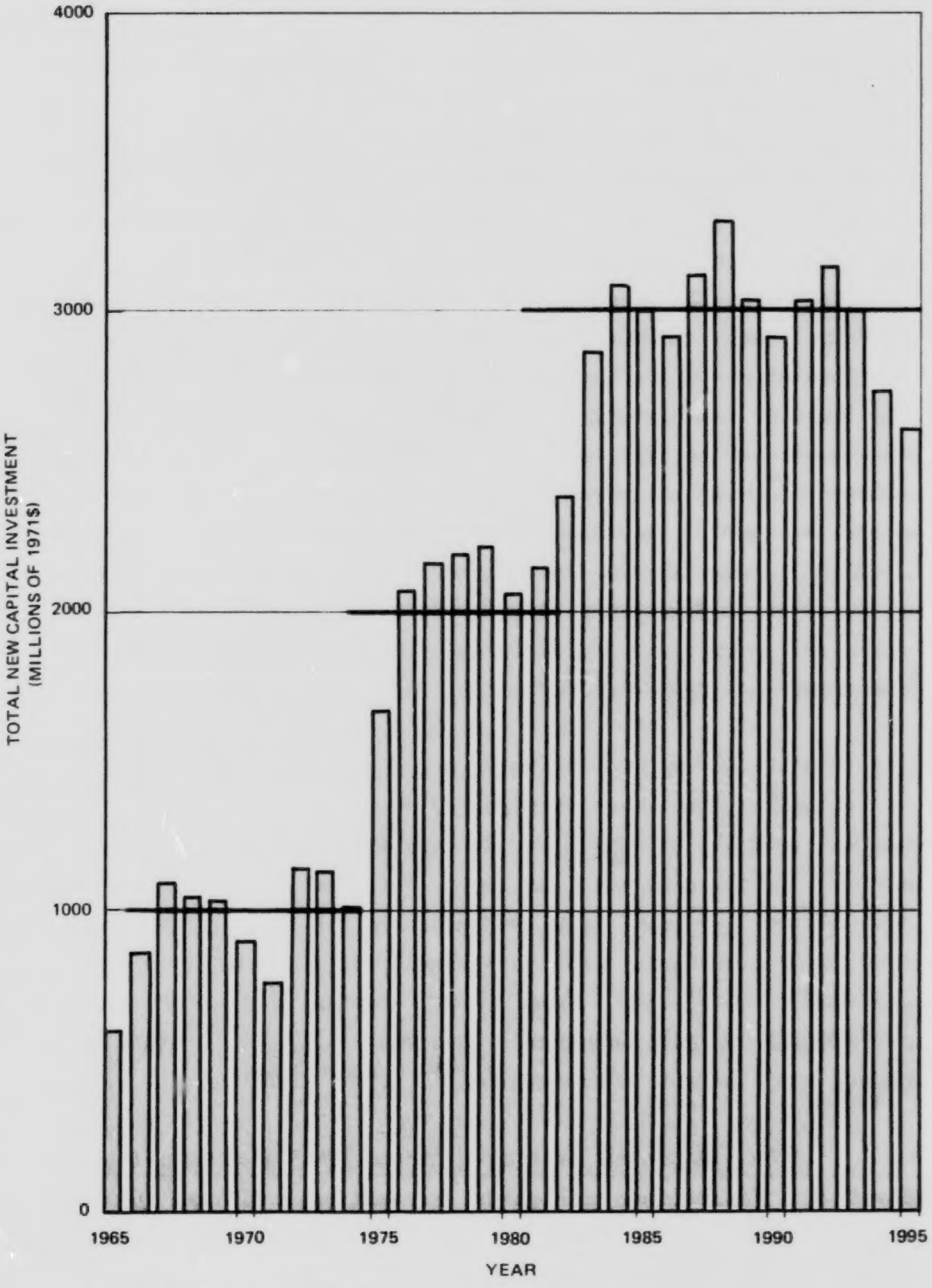
The level of new capital investment, a key element in generating economic growth, is influenced to a very large degree by the rate at which Alberta's non-renewable hydrocarbon resources are developed. Figure 6 illustrates the 18-year historical trend and the Reference Case projection of total new capital investment in the Province in constant 1971 dollars. During the 1960s and early 1970s new capital investment approached an average of $1.0 billion per year. Beginning in 1975 (with the construction of the Syncrude project, accelerated activity levels in the conventional oil and gas industry, as well as rapid expansion in the commercial and residential construction sectors) the level of new investment increased to over $2.0 billion per year in real terms. The Reference Case projections indicate that if the assumed levels of oil sands and heavy oil development take place, total annual new capital investment will increase to approximately 3.0 billion per year. These capital investment data are a clear dimensionalization of the economic boom which Alberta has experienced during the last five years and what might be expected during the next decade, given an environment of investor confidence.

An analysis of the major components of new capital investment by key sector, as shown in Figure 7 for the Reference Case, provides another measure of the relative significance of future oil sands activity to the provincial economy. This bar chart provides a breakdown of the Reference Case projection of new capital investment into four major components: (i) oil sands; (ii) conventional oil and gas and coal mining; (iii) specifically defined industrial projects in petrochemicals, pulp and paper, etcetera; and, (iv) total investment in all other sectors of the economy.

The Reference Case projections indicate that the net new investment in combined oil sands, conventional oil and gas and coal mining industries, estimated at over $60 billion in constant 1979

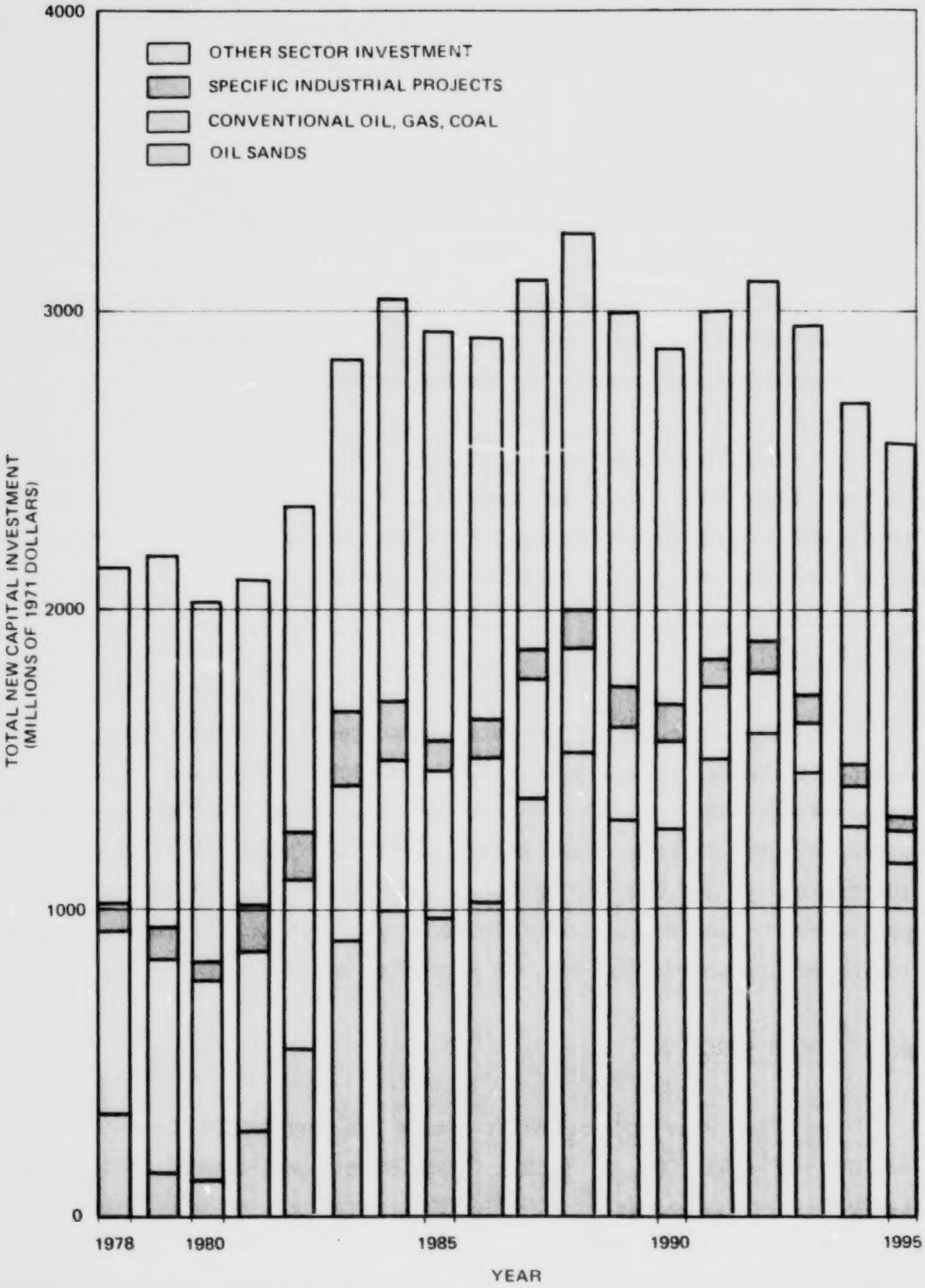
NEW CAPITAL INVESTMENT IN ALBERTA

(HISTORICAL SERIES AND REFERENCE CASE PROJECTIONS)
(CONSTANT $1971)



SOURCE: FOSTER RESEARCH

FIGURE 6



PROJECTED CAPITAL INVESTMENT IN ALBERTA
(BREAKDOWN BY MAJOR COMPONENT)
(CONSTANT $1971)

SOURCE: FOSTER RESEARCH

FIGURE 7

dollars, could represent over 50 per cent of total new investment in Alberta, during the period projected by the model. This compares with 32 per cent of total new investment represented by the energy industries sector during the 1962-1977 period.

Because of the overwhelming magnitude of prospective new capital investment in hydrocarbon resources, the relative economic impact of the foreseeable new investment in other processing and manufacturing activities such as petrochemicals, will be overshadowed by the combination of both the direct resource development activity and the induced indirect supporting sector activities.

Detailed analysis indicates that substantially more new capital investment would be required if the average growth rate for total GDP during the forecast period were to approach the performance of the economy during the past 15-year period.

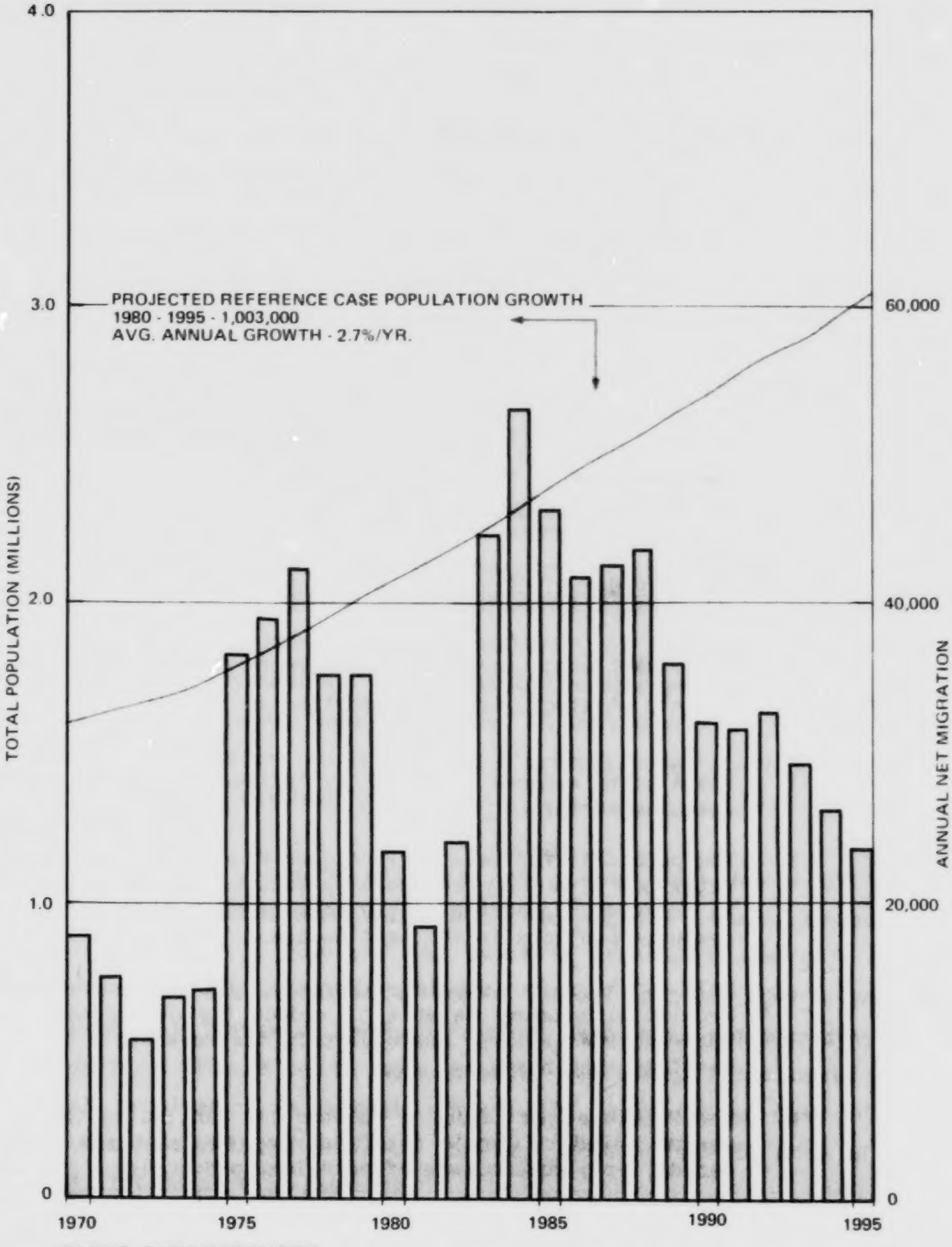
5. POPULATION

The econometric projection suggests a total Alberta population increase of approximately 1,000,000 during the fifteen year forecast period. Of this increase, the model estimates that net migration to Alberta from other parts of Canada will account for approximately 550,000. The total Provincial population in 1995 is projected to be 3,073,000. Figure 8 provides a graphical representation of the population and net migration estimates.

6. LABOUR FORCE

The Provincial labour force is projected to increase by 471,000 to 1,417,000 by 1995. Total direct employment in the energy sector is estimated at 65,000 in 1995, representing only 4.6 per cent of total Provincial employment. The major increases in employment are expected to occur in the services and trade sectors, as these parts of the economy expand in response to the major resource development projects.

ALBERTA
POPULATION AND NET MIGRATION



SOURCE: FOSTER RESEARCH

FIGURE 8

Inherent in these employment opportunities will be the continuing need to provide for highly skilled professional, management, technical and trade personnel.

7. ALBERTA HERITAGE SAVINGS TRUST FUND

In addition to the outlook for continued strong economic growth, the next fifteen years will be affected by an additional element with potentially significant influence on the direction of the economy. That element is the substantial transfer of depleting resources (fixed assets) into liquid assets, as a consequence of petroleum production. These assets will be accumulated by the Provincial Treasury as budgetary surpluses and as transfers to the Alberta Heritage Savings Trust Fund (AHSTF). The AHSTF will represent an extremely significant tool in terms of the implementation of a provincial economic strategy.

C. MANAGING THE DEVELOPMENT OF ALBERTA'S RESOURCE BASED STRENGTHS

The environment which serves as a framework for an assessment of Provincial economic strategy, can be summarized as follows.

1. The Alberta economy is currently "driven" by the natural resource sectors.
2. The potential for relatively higher Provincial inflation rates and a variety of social pressures can be expected to increase, depending on the rate of development of new resource projects in the next decade.
3. Only with major public policy initiatives will the Provincial economy be able to reduce its dependence on the resource sectors, and diversify its relatively small manufacturing base.
4. The Province can expect a substantial continuing transfer of fixed to liquid assets during at least the next decade, as a consequence of petroleum production.

These are the realities which will impinge upon the management of Alberta's resource based strengths. An examination of specific problem areas and suggested policy considerations related to maximizing the economic impact of Alberta's major resource industries is contained in the following pages.

1. CONVENTIONAL OIL AND NATURAL GAS

The problems inherent in the effective management of Alberta's conventional oil and gas strength are almost self-evident: the solutions to those problems are elusive, at best.

Reserves and producibility of primary and secondary light and medium crude oil are on a long term decline which is not likely to be reversed, although there may be an occasional, temporary, respite due to new discoveries of consequence. The main hope for a lessening of the rate of decline lies in the development and implementation of tertiary production techniques which give rise to an increased recovery factor in reservoirs that are responsive to such techniques. The replacement of primary and secondary production with tertiary and even more "exotic" production is, however, a time-consuming and expensive proposition involving a major commitment of research and pilot plant effort and substantial injections of development/production capital. The critical ingredients to success in this direction are the restoration of investor confidence and a product price which will make the whole exercise worthwhile.

The resource potential of conventional heavy oil in the central-and-southeastern portion of the Province is widely regarded as being enormous. However, the existing reservoirs are difficult to produce and the asphaltic nature of the oil in crude form is such that markets are limited. Improved recovery techniques and upgrading of the resulting production to more broadly acceptable forms could resolve both problems -- at a cost. Again, it would appear that price and investor confidence will be the key determinants to more effective utilization of this resource.

Natural gas and its attendant by-products perhaps constitute the largest variable in the conventional energy equation, but it would appear that there is growing confidence that this resource potential is, indeed, much larger than previously has been recognized. However, the deeper horizons, lower permeability and increasing remoteness of the resource, singly or in combination, make the practicality of eventual recovery extremely price-dependent. This situation is further aggravated by lack of markets, either price or politically induced. Traditional methods of market enlargement, whether through substitution of other fuels or extension within Canada, or increased exports to the U.S., will require that a fine balance be established between the total real costs associated with converting potential reserves into production on the one hand, and the price of competing energy sources in the various market places, on the other.

During recent years it has been clearly established in Canada, the U.S. and abroad, that the conventional oil and gas resource base is expandable and will be expanded, given producer net-backs which are sufficiently encouraging and given an overall environment which is conducive to risk-taking. There is no question that such is the case in Alberta.

Given this fact, coupled with a recognition of the unpleasant realities of Canada's economic future if the nation fails to fully exploit its energy potential, it becomes almost redundant to suggest the following. One of Alberta's major policy thrusts will have to be continued efforts in the direction of re-establishing an environment of investor confidence through the development of a Canadian energy pricing and market policy and a fiscal regime which are economically, politically, and socially acceptable.

Such a policy thrust can (and should) be complemented by continued, and even increased, support of activities designed to: (i) improve the recovery efficiencies of light and medium crude oil reservoirs; and, (ii) overcome some of the technological and market impediments to major exploitation of Alberta's conventional heavy oil resource. It might also be appropriate to employ such a device as Provincial corporate income tax policy to encourage the multi-faceted oil and gas service industry, which is already centred in Alberta, to remain headquartered in the Province, even as their operating activities take them to the frontier areas and even abroad.

2. OIL SANDS

It is generally recognized, and has been quantified in relative terms in this study, that future oil sands development will have a major influence on the future of the Alberta economy. Most current assessments of Canada's future energy needs indicate that, even with success in the frontier oil areas, Canada will need one new oil sands plant onstream at least every three years, in order to make dramatic progress towards energy self-sufficiency. The Reference Case econometric projections indicate that the combined new capital investment in all major oil sands projects could equal 32 per cent of total new investment spending in Alberta during the 1980-1995 period, if development at such a rate were to materialize. As a result, a Provincial oil sands policy aimed at developing this resource at the maximum practical rate, without overheating the Provincial economy, is obviously in the Province's best interest. Any major delay in oil sands development would undoubtedly slow the rate of overall long-term economic growth and specific industries dependent upon such activity would either not develop, or would experience limited growth.

The planned, orderly, exploitation of this vast energy resource is not without significant problems. It will be necessary to continue to face these problems and to implement solutions if oil sands development is to provide maximum economic benefits to Alberta. Four of the most critical problem areas are:

- lack of resolution of royalty and tax agreements between the two levels of government, exemplified by the fact that it will be almost ten years before the next generation of plants can follow Syncrude;

- shortages of skilled manpower in all phases of project development and operation, including engineering design teams, skilled construction trades and plant operating and maintenance personnel;
- technological constraints, most prominent of which are the significant barriers to be overcome before the vast majority of the oil sands deposits can be considered economically exploitable;
- the massive capital commitments required for current and future projects.

Other impediments to oil sands development include environmental concerns over land reclamation and acid rain, possible water shortages for in-situ operations; logistics and traffic problems for both people and materials; and, machinery and equipment availability.

A Policy Program For Oil Sands Development

In dealing with royalty and taxation uncertainties, a concerted policy thrust towards a standard fiscal regime for all oil sands projects may be required if development of these resources is to take place at the pace required to meet national energy requirements and to maintain stable economic growth in Alberta. The basic regime would include a formula or a mechanism for establishing synthetic crude oil selling prices, Provincial royalty and tax regulations as well as Federal Government tax and tariff policies. This would require agreement with the Federal Government and would not be easily achieved. However, eliminating a substantial element of uncertainty and reducing the long delays inherent in the current method of negotiating with private sector developers and the Federal Government on a plant-by-plant basis is well worth pursuing. Because of the possibility of rapidly changing technology in future oil sands development projects, consideration may have to be given to a cost of service approach, with built-in incentives to encourage cost-efficiency.

The financing problems facing the oil sands industry could be alleviated by a continuation of Provincial funding of a portion of the new capital investment required to build new oil sands projects. By this means the Government would ease the pressure on Canadian capital markets and reduce the overall national requirement for foreign borrowings. Based on the econometric model projections of royalty revenue and the new capital investment which likely will be required for oil sands development during the period 1980-1995, it appears that the AHSTF could supply a meaningful portion of the total financing for all major oil sands projects.

The problem of shortages of skilled manpower for future oil sands development could be attacked on two fronts, with the first involving a scaling up of the efforts to monitor the future demand for labour currently being undertaken by the Department of Advanced Education and Manpower and other Government departments. The creation of a single co-ordinating agency would enable the Province to monitor short, medium, and long-term manpower needs in specific skill categories and provide the ability to maintain continuously updated forecasts of the labour demand associated with major industrial and resource development projects.

The second area of concentration on manpower problems would involve the upgrading and restructuring of Provincial educational programs so that they are capable of producing graduates with the skills required by Alberta industry. These educational programs would have to be aimed, not only at attracting Albertans, but students from other parts of Canada as well. If the outlook for future job opportunities could be clearly communicated to other Canadians, the effects of the problem of an apparent lack of mobility of Canadian skilled labour might be reduced.

In the area of technological constraints, the creation of AOSTRA and the provision of substantial funding of oil sands research is a very positive component of the Government's oil sands strategy.

However, it may become necessary to make adjustments to certain aspects of the program to enable more basic research to be done in Alberta. One apparent constraint is the lack of a more fully developed R and D environment in the Province.

3. AGRICULTURE

The agricultural sector is an extremely important part of the basic fabric of the Province, with farm cash receipts in excess of two billion dollars per year, the processing of agricultural outputs representing a significant and potentially growing part of the manufacturing sector, and agricultural activities currently utilizing a large portion of the Province's land area. Agriculture also constitutes a renewable resource. It provides a multitude of indirect jobs, with the economies of many rural communities being dependent on the sector. In 1979, agriculture accounted for about five per cent of total Provincial GDP, when measured in constant 1971 dollars, and employed nine per cent of the labour force. However, the high growth agriculture scenario examined during the conduct of this study indicates that even under optimistic conditions, the percentage contribution to Provincial GDP will decline to approximately three per cent by 1995.

If the primary production component of the agriculture sector is to achieve a greater portion of its potential over the forecast period, policies will have to be directed toward the following major problem areas.

(a) Marketing is a fundamental constraint to growth of agriculture in Alberta. A number of factors affect the combined Provincial marketing effort including:

  - Alberta is a region of relatively high cost production due to climatic conditions;
  - individual producers are production, rather than market, oriented;
  - a lack of marketing brokers, middlemen and intermediaries has resulted in relatively unaggressive

marketing efforts and an absence of appropriate levels of market research and communication.

(b) The physical quantities of grains which Alberta can export are critically dependent on, and presently constrained by, the transportation/distribution system.

(c) Agriculture is constrained more by climate than by lack of arable land. The physical potential of the agricultural land base is not a constraint to increased output. The land base is considerably under-utilized because many producers do not fully take advantage of existing technology and consider it uneconomic to bring additional land under cultivation.

(d) A generally buoyant economy will make competent farm labour and managerial talent difficult to attract.

Other problem areas involve financial constraints facing farmers, relatively poor output from solonetz soils, and encroachments on agricultural land from residential, transportation and industrial growth.

Policies, some of which are already substantially in place, directed towards solving some of the main hurdles to optimum development of the agriculture sector, could include the following.

- Continued support and attempts to expedite a change from statutory to compensatory freight rates. It is essential that the initial change takes place as quickly as possible, if grain and seed exports from Alberta are to increase significantly in response to expectations of strong international demand over the next 10 to 15 years. Continued initiatives in the areas of grain handling and grain transportation can be directed towards moving larger quantities to more markets more quickly. (Steps taken to date include support for the Prince Rupert Terminal project, major hopper car purchases and the Alberta Grain Terminal initiative.)

- Modified taxation policies, especially those which could stimulate processing and upgrading of agricultural products. The Alberta Corporate Tax and Business Incentive Policy could be of assistance if specific tax incentives were developed.

- Programs aimed at easing some of the high costs of entry to new markets which have discouraged private Alberta marketing efforts. A major component of such programs could be the financing of in-depth research into international markets.

This research effort could help to establish the nature of the proposed market; the methods and customs of doing business in other countries; distribution channels; demographics; income-expenditure patterns; and, consumer preferences.

- Because climatic constraints are so fundamental to crop production, research into climatic trends and to the further development of early maturing species should be encouraged. Although not specifically tied to climatic problems, increased livestock and soil research appears desirable.
- Considerable rehabilitation of existing irrigation systems, including drainage and saline water disposal, will have to be undertaken if the existing potential of irrigated areas is to be maintained.

Agricultural Products Processing

The processing of agricultural products is recorded by the statistical agencies in the Food and Beverage Industries segment of Manufacturing. Since the Food and Beverage segment accounts for approximately one-third of Alberta's manufacturing sector shipments of goods, agricultural product processing is an important part of Alberta's economy. Over the next decade and a half, Alberta's agricultural products processing is expected to grow at a rate similar to population growth. Some acceleration is probable as the Province's population reaches the point where it becomes advantageous for local and out-of-Province processors (primarily central Canadian operations) to establish plants to use Alberta-produced raw materials for local and regional markets in replacement of production from plants currently outside Alberta.

Alberta processes about 40 per cent of Canadian beef products. Slaughtering and processing of meat is by far the largest part of Provincial agricultural products processing, accounting for slightly more than half of the Food and Beverage Industry section of Manufacturing and Shipments of $1.1 billion in 1977. Alberta producers are well established in supplying Provincial beef markets and the large Montreal market. With greater future production of boxed beef at the packing houses (block-ready cuts of beef as opposed to traditional sides), Alberta processors should show volume increases. A number of other factors will impact on the future growth of the important beef slaughtering and processing industry in Alberta including: availability of adequate cattle supplies, feed grain costs, ability to retain the Montreal area market and Saskatchewan's policies with regard to processing its large cattle population (at present Saskatchewan processes only a small portion of the beef it produces). Hog processing, not nearly as large a part of agricultural products processing as beef, has declined in recent years. However, it is expected that hog numbers and levels of processing activity will increase in the Province.

Alberta grown fresh vegetables supply only a limited part of demand. Production could be increased through more dedication of presently irrigated land to vegetable crops, increased irrigation acreages, greater use of greenhouses, etcetera. However, climate-wise, the Alberta producer is at a distinct disadvantage to the California or Mexican producer. Given other crop alternatives, vegetable production appears to have limited growth possibilities in the Province. Processing of vegetable products, is of course, tied to production levels of vegetables themselves.

Flour milling, malt production, alfalfa processing, linseed oil manufacture, cereal grain processing and honey processing are not expected to show major growth during the next 15 years. Demand for feed mill output is tied closely to livestock numbers, with major growth unlikely. The processing of rapeseed has grown rapidly in the Province, with future major growth dependent in part on establishing rapeseed meal as substitutable with soybean meal (as livestock and poultry supplements) and acceptance of rapeseed oil for human consumption in the United States. Some growth in the processing of sugar beets may occur as manufacturers using large quantities of sugar seek to obtain plants near an Alberta sugar source, so as to supply Provincial and perhaps regional markets with products currently shipped from outside the region.

4. PETROCHEMICALS

The support of developments in this industrial area has been a major component of Provincial economic strategy during the past decade. This Government encouragement, plus the relative security of feedstock supply and favourable feedstock prices (as compared to some other major chemical producing areas in North America and Europe), has resulted in the establishment of several major world scale ethane-based petrochemical facilities in the Province. At full capacity, production from these new petrochemical plants will effectively double the value of total output in the chemical industry in the Province and represent an important new increment to economic activity. Policies which encourage the further processing and upgrading of natural resources within Alberta obviously represent a prime example of capitalizing on resource based strengths and should continue to be pursued. If these projects have a major Alberta ownership the net benefits to the Province will be further enhanced. Concern over the establishment of an industry based on an ultimately depleting natural gas base can be offset, to a considerable degree, by the long-term potential of using the Province's other major energy resources - oil sands, and coal, as future sources of feedstocks.

The rate at which this industry expands during the fifteen year forecast period is directly related to the size of future export markets (primarily those of the United States, plus world markets for some specific petrochemicals) which can be captured by Alberta based producers. The relative price competitiveness of Alberta manufactured petrochemicals as compared with other primary chemical producing areas (the U.S. Gulf Coast, Mexico and some Pacific Rim countries) will be a key factor in determining the size of these future export markets. Of the four major industry cost components (feedstock costs, plant capital costs, transportation costs and foreign tariffs) Provincial Government policy initiatives can be directed most readily at influencing feedstock costs and negotiations with respect to tariffs.

The study findings indicate that a reduction in the average cost of eleven Alberta produced primary petrochemicals, which would be effectively equivalent to the complete elimination of the existing U.S. tariffs, might result in a $1 billion (constant 1979 dollars) incremental increase in petrochemical industry capital investment and the addition of approximately 900 incremental direct jobs during the period 1980-1995. This incremental level of activity can be compared with the Reference Case industry expansion (assuming existing tariff levels remain) which predicts $3 billion of new capital investment and the addition of over 3,000 new direct jobs. The indirect effects of such incremental expansion are estimated, in total, to produce a significant 1.6 per cent increase in total Provincial GDP by 1995.

The relative magnitude of the increase in petrochemical industry activity, which might be anticipated from an elimination of tariffs, indicates that the Provincial Government should continue efforts to try to achieve a substantial reduction in U.S. tariffs. However, the policy option with respect to feedstock subsidies should be pursued with caution and only if a careful assessment of the total costs and benefits to the Province shows a positive balance in favour of stimulating industrial development by feedstock subsidy. Major direct Provincial feedstock subsidies might also involve the risk of U.S. retaliation via the enforcement of anti-dumping legislation and other trade sanctions.

Future petrochemical industry developments will represent a significant part of manufacturing industry growth during the next decade. However, the industry's potential contributions must be viewed from a perspective of the total Provincial economy and not just the potential of the existing manufacturing base, when assessing the degree to which the Provincial economic strategy and corresponding policy initiatives should be focussed in this area.

5. COAL

Coal represents an important long-term energy resource. The rate of coal development is difficult to forecast because it will be greatly influenced by technological advances which will change the economics of its exploitation and use. Substantial volumes of Alberta thermal coal will be required to supply the Province's electric generating requirements and the production of metallurgical coal for Canadian and world export markets should expand considerably over the fifteen-year period of this study. Several major problem areas will affect the rate of development (assuming existing technology) of both thermal and metallurgical coal including:

- high transportation costs to relatively distant markets;
- environmental constraints related to land use issues;
- infrastructure requirements to support new projects;
- general regulatory parameters including health and safety aspects and fiscal regimes.

Resolution of the issues associated with these problem areas requires the determination of priorities and the development of a number of policies. However, it is a policy thrust toward the acceleration of research and development, and the effective monitoring of new technologies developed in other parts of the World, which will keep the Province in a strategic position to exploit its coal resources as rapidly and effectively as possible. Modest programs in this direction have been carried out in the past and the Alberta Research Council's current long range plan proposes a stepping up of its activity in this area. Because of the inherent flexibility and value of liquid fuels, coal liquefaction may offer the greatest long-term potential for development of this resource.

6. FOREST PRODUCTS

Alberta is richly endowed with timber reserves, about 65 per cent of which are unallocated either to forest management agreements or quota cut. Much of the timber available for commercial production is located in Northern Alberta.

Total value of production of forest products in Alberta accounts for a small portion of Gross Domestic Product. However, the Wood Products and Pulp and Paper industry accounts for about 12 per cent of total employment in the Alberta manufacturing sector. The industry is important to the economy of the Province for a number of reasons, including:

- it is a renewable resource. Therefore, further development of the industry is consistent with a basic objective to reduce Alberta's dependence on non-renewable resources;
- because the bulk of undeveloped timber limits are located in remote areas, further development of this renewable resource, on a sustained yield basis, will contribute to the balanced growth objective of the Provincial Government. Further, if uncommitted timber limits are not harvested on a sustained yield basis at maturity, they move into an over-mature or decay phase of the growing cycle with real economic loss to the Province;
- certain characteristics of wood pulp made from Alberta spruce and pine make them highly desirable as raw material for the manufacture of relatively high value paper products.

A number of problem areas will have to be resolved before uncommitted timber limits within the Province can be harvested and marketed on an optimal basis. The most critical problems include:

- transportation costs are higher than competitive sources of supply because of our land-locked position. Further, these costs are non-controllable and allegedly are based on "what the traffic will bear";

- our forests are relatively slow-growing, particularly when compared to species grown in competitive areas such as the southeastern United States;
- Alberta lumber, plywood and pulp producers are heavily dependent on export markets which are cyclical both in terms of demand and prices;
- lack of infrastructure, particularly road and rail facilities, in areas where potential development of the industry is possible.

A forest products policy to resolve these key problem areas should include a long-term commitment to expanded and Government-financed basic and applied research in the broad area of forest management, with emphasis on Alberta species. In particular, forest experimental stations could be established to explore: (i) aspen utilization; and, (ii) silviculture and forest management practices designed to reduce the growing cycle. Since such research activities would be located in remote areas close to timber limits, they would contribute to balanced growth of the economy.

Other policy actions which could help to improve the competitive position of the industry relate to infrastructure needs and power costs. Extended rail and road systems that would permit more direct routing of wood chips from sawmills to pulp mills would be helpful. Further, the economics of a high energy use thermo-mechanical pulp mill in Northern Alberta could be improved through reduced power costs.

7. TOURISM

The tourism system in Alberta is made up of four major components: the resident and non-resident tourists in the Province; the businesses providing tourist goods and services; the governments of the host region; and, the host community. Tourism includes business and convention travel.

The tourism industry in Alberta generated revenues of about $900 million in 1978, or about 3.5 per cent of GDP. Despite these revenues, which are distributed widely throughout the Alberta economy, it is estimated that Alberta experienced a Provincial travel deficit of $125 million in 1978.

There are a number of major constraints which are seriously hindering the development of tourism in Alberta, including:

- tourism is highly concentrated in Banff, Jasper, Calgary and Edmonton. The capacity of the National Parks is inadequate to meet demand. Because of the lack of sufficient facilities, those in existence tend to be crowded during certain periods;
- apathy or resentment towards tourism on the part of the general population;
- the attractiveness of investment opportunities in other segments of the economy, and the pressure to develop other more sophisticated industries, has diverted attention from tourism in the establishment of government investment and development programs;
- difficulties in recruiting, developing and retaining qualified staff in the tourism industry.

Key strategy options directed towards eliminating the constraints identified above are:

- initiation of a long-term tourism planning, investment and development program in co-operation with private sector organizations. (The Province could sponsor the preparation of a master tourism policy for Alberta as one of the first steps in initiating this program);
- in enunciating the broad role which it feels the tourism industry should play in the future social and economic development of Alberta, reconsideration should be given to the philosophy that tourism is strictly an economic phenomenon; and that recreation and tourism should cease to be viewed as wholly separate entities for purposes of government planning and investment;
- formal commitment to the development of additional tourism and recreation destination complexes in areas

outside the National Parks following the concept of Kananaskis Country;

- policies directed towards substantially increasing the flow of investment into tourism development over the next 20 years could take two forms:

  (i) direct investment in public facilities and infrastructure; and,

  (ii) programs to stimulate and facilitate financing for innovative private sector tourism/recreation facilities;

D. THE CREATION OF NEW ECONOMIC ACTIVITIES OF MAJOR SIGNIFICANCE

The foregoing section, and the economic analyses contained in the study suggest that, although the road will not be smooth, Alberta's economy over the course of the next decade will be healthy, and perhaps even robust. New jobs, new wealth and growth at an acceptable rate and in reasonable balance with the expectations of Alberta's citizens, all appear to be within reach. As a consequence, the following questions legitimately can be asked.

- Why does a policy thrust directed towards major diversification of the economy still make sense?
- If this diversification goal is in fact valid, does such a policy thrust have to be pursued with significant imaginative, and potentially difficult Provincial Government policy actions?
- What are the key elements in orienting such a strategy?

1. WHY DIVERSIFY?

A long-term goal of diversifying the provincial economy has been one of the strongly articulated economic policies of the Provincial government since 1971. For example in an October 1974 address to the Legislature, Premier Lougheed expressed concern that the Alberta economy "is too vulnerable and too dependent upon depleting natural resources for the continued prosperity of our citizens...." Some definite progress towards diversification has been made.

This study has re-examined the issues and arguments related to a diversification strategy and the results strongly reinforce the government's 1974 position that Alberta must continue to pursue a strategy of economic diversification.

Outlined below are seven arguments which support a strategy involving a continuation of attempts to restructure the economy, so that it is less dependent on the natural resource (and particularly the energy) sectors.

- There are severe risks associated with pursuing a Provincial strategy which relies upon energy sector developments (and the supporting economic activities which they induce) as the only major driving force with sufficient magnitude to maintain Alberta's current economic momentum. If the projected level of oil sands activity were to be substantially reduced, the reduction in the rate of overall economic growth of the Provincial economy could be substantial.

- A focussed diversification of the economy should remain a primary policy objective if the Province's economic strategy is to be aimed at generating a broad spectrum of the highest quality employment opportunities for future generations of Albertans.

- It would be in Alberta's, as well as the national interest, to utilize at least part of the Province's financial assets to stimulate areas of economic activity where Canada is lagging behind the rest of the world. Alberta initiatives, in this area, could help strengthen the competitive position and prosperity of the total Canadian economy.

- The existing confrontation with the Federal Government and other Provinces, over their perception of wealth accumulating in Alberta could be substantially reduced if a greater portion of these assets was directed toward a strategy and programs which could be seen by other Canadians as being in their long-term economic interest.

- Diversification will not occur to any significant degree as an inevitable result of the massive energy sector developments prospective for the next decade. It will only occur as a result of the implementation of specific strategies by government.

- The Province of Alberta has the financial resources necessary to contemplate pursuing a strategy of economic diversification. The Alberta Government is in a unique position, relative to other governments, to take the leadership in initiating and directing a program to stimulate the development, for example, of knowledge and technology-intensive industry. The necessary funds are available to the Provincial Government. It does not have to increase taxes or create larger deficits in order to carry out such a program.
- Assuming the Provincial Government is prepared to accept a planning timeframe beyond the next decade, now is the time to reinforce a long-range strategy of developing a replacement source of economic growth in anticipation of the ultimate decline in hydrocarbon-based resource activity.

2. WHY TAKE MAJOR INITIATIVES?

Since the goal of economic diversification remains as valid today as it did in the early 1970s, why does such a strategy have to be pursued with significant, imaginative and potentially difficult Provincial Government policy actions?

It probably is impossible for the Federal Government to design and manage a really effective program in this area, because of its current financial position and because of the myriad of competing, and even conflicting interests with which it must deal. Given the present positive economic climate in Alberta and the existing Provincial political situation, the Alberta Government has the opportunity and perhaps the obligation, to take some of the bold initiatives required.

However, the range of strategic diversification options available to the Province is limited by the realities of a regional economy. There are many impediments to the development of major manufacturing industries in Alberta, which have been addressed and discussed many times. These include small local markets, long distances from major continental and world markets, national tariff and transportation policies, etcetera. In developing an economic strategy for the Province, it is necessary to recognize the weaknesses inherent in our position.

In general, an examination of the goods producing sectors of the economy indicates that the existing manufacturing activities in Alberta (both the smaller operations oriented toward serving local and regional consumer and commercial markets, as well as major manufacturing enterprises serving the resource development sector) will grow in response to the increasing regional population base and the expansion of resource development activities. Because of comparative disadvantages with other regions, the existing manufacturing industries (with a few exceptions) cannot be expected to produce a significant percentage of their output for export markets. Some Alberta manufacturing enterprises have developed, and will undoubtedly continue to develop, profitable and viable export markets (for example, ATCO, Foremost and a few other specialized equipment manufacturers) but, in the future, such operations are not expected to be of sufficient size to significantly increase the manufacturing sector percentage contribution to total Provincial GDP. Obviously, policies aimed at maximizing Alberta content in materials and equipment procured for major resource development projects is of substantial benefit to the Alberta economy and should be pursued to the extent that it makes economic sense. However, by itself, this will not ensure viable export oriented industries in the long run.

Because the majority of the existing Alberta manufacturing base is dependent upon, and will develop essentially to serve, a regional resource extraction oriented economy, a strategy aimed at stimulating the formation and development of new export oriented industries is likely to be the most appropriate. If the goods producing sector of the economy is to be expanded, with the goal of gradually supplementing and in the very long timeframe replacing the resource sector as the major driving component of the Alberta economy, access to export markets will be essential. The Provincial Government has moved in this direction - i.e., Alberta is the only provincial government with a minister responsible for external trade.

The general characteristics of some theoretical "optimal" new industry for Alberta have often been identified and include such elements as; the production of products with a high value-to-weight (or bulk) ratio, so as to minimize the impact of transportation costs; providing highly skilled employment opportunities; being non-polluting, etcetera. The many, varied perceptions of such ideal industries are often assumed to be covered under the general umbrella description of "high technology". Although this designation can include a broad spectrum of industrial activities, and the distinctions between high and low technology are often blurred, it is generally recognized that knowledge and technology-intensive activities represent the leading edge of industrial development. It is these types of industries which will represent a key component of economic growth in the major industrialized countries of the world during the next several decades.

As part of the conduct of this study, high technology industries were examined in general terms. Three industries with significant growth potential and other characteristics compatible with Alberta's long range development objectives were identified. These were pharmaceuticals, telecommunications equipment manufacture, and microelectronics. (See Section B., Appendix B, for a summary description of these industries.)

E. KEY ELEMENTS IN A STRATEGY AIMED AT INDUSTRIES OF THE FUTURE

1. WORLD PERSPECTIVES

One inescapable conclusion comes from even the briefest examination of the world of "high technology" - that being that there is no inevitable correlation between successfully conducted research and development, on the one hand, and commercial exploitation on the other. Therein lies an important lesson for those in Alberta who would tend to simplify the technological process.

From the end of World War II until the late 1960s the United States was the Free World's acknowledged leader in the conduct of basic research and in the discovery of new technology. Since 1945, the United States and the United Kingdom have won 70 per cent of the Nobel Prizes for science and have accounted for 75 per cent of the world's radical breakthroughs in technology. During the same period, West Germany has accounted for only seven per cent of the Prizes and Japan for just three per cent. Yet, the countries who are currently regarded as leaders in the exploitation of advanced technology - the innovation and commercial development process - include West Germany, Japan, South Korea, Taiwan, Denmark and France.

A number of reasons are advanced as to why Japan and Western Europe have been so successful in the field of innovation and commercialization and North America, notably the U.S., has fallen so far behind. One principal reason is the matter of national priorities and the ability to focus upon "industrial policy". The impact of that phrase, which describes a set of practices or programs in which government is much more intimately connected to industry than as a mere provider of the broad economic and legal settings in which business operates, has spread throughout Europe since World War II. Initiated by French and Italian determination to develop industrial parity with their more advanced northern neighbours, "industrial policy" has since become a definable part of national policy, throughout the Common Market.

In Japan, industrial policy has become so clear and coherent that the integration of business, government and quasi-governmental organizations and state planning have become known around the world as "Japan, Inc."

Both the Europeans and the Japanese long ago determined, in a manner unacceptable in North American society, that reliance on the workings of impersonal, so-called free markets was not adequate to produce economic growth and economic security at a socially acceptable pace and in socially acceptable ways. These nations identify high growth industries and support the applicable technology with education, research and related social policy. Capital support is provided by intervention in the credit markets. Similar interventions help declining industries to overcome competitive shocks. Selected industries are further supported by the importation of foreign technology and know-how and through administrative procedures and other non-tariff barriers, subsidies and tax measures.

National industrial policy is not, of course, the only reason for the commercialization phenomena. South Korea, Taiwan, Ireland and Spain have ridden to the forefront primarily on the basis of low-cost labour and purchased technology, which provides a base from which to grow as a result of their own research and development activities. In some cases, this is said to have resulted in the licencee exporting, to the licensor countries, third generation products that are superior to those of the licensors.

Another major force contributing to the decline in U.S. technological eminence has reportedly come from within. In a recent publication of the Business Intelligence Program of SRI International, it was suggested that one of the villains is a major pre-occupation in U.S. industry with short-term gains, derived from product improvement, new applications of existing technology and the search for lower labour costs through mechanization and automation. These kinds of activities obviously produce earlier profits, at substantially lower risk, and with a more immediate and positive image for senior management. The satisfaction of the growth ethic, by such organizations, has been achieved through the acquisition route rather than from within, using technology as a base. Unquestionably this attitude was given a boost in the U.S. by tax dis-incentives with respect to corporate long-term capital gains and the inability to write off research and development expenditures against current income.

Another problem has been the pre-occupation, during the 1970s, with private sector research aimed at environmental protection and significant public sector research and development spending oriented towards defense, as opposed to economic development. According to the OECD, 1974-75 U.S. government research and development expenditures directed toward economic development approximated 9 per cent of the total, compared with 23 per cent, 26 per cent and 21 per cent in Japan, France and the United Kingdom, respectively.

As a consequence of the foregoing, total U.S. research and development expenditures in real terms have remained essentially flat since 1969 as have R & D employment levels. By contrast, scientists and engineers engaged in such activities in Japan have doubled, on a per capita basis since 1965.

2. THE CANADIAN PERSPECTIVE

Perhaps many of these problems exist in Canada as well, although it seems likely that much of the attitude of U.S. business has been inherited naturally, as a consequence of Canada's branch plant economy. One commonly accepted measure of the degree of pursuit of the advantages inherent in knowledge and technology-intensive industry, is the proportion of gross national product invested by a nation in research and development. The enormity of the shortfall of Canada in this regard is indicated on the following tabulation:

RESEARCH AND DEVELOPMENT EXPENDITURES RELATIVE TO GROSS NATIONAL PRODUCT

Country	1975	1979
	(Per Cent)	
West Germany	2.1	N/A
United Kingdom	2.1	N/A
Netherlands	2.0	N/A
France	1.8	N/A
Sweden	1.8	N/A
Italy	1.0	N/A
Spain	0.3	N/A
United States	2.3	2.4
Japan	1.7	2.0+
Canada	N.A.	0.9

N/A - Not readily available.

SOURCES: SRI International, Northern Telecom Canada Limited.

During the course of an address to the recent Financial Post Conference on Innovation, Mr. B. A. Beneteau, President of Northern Telecom Canada Limited indicated that some ambitious programs have been embarked upon by several nations, in pursuit of their national strategies regarding electronics development. The Japanese government has designated the integrated circuit, telecommunications and computer industries as being vital to the nation and therefore targeted for growth. As a consequence, it has scheduled a one billion dollar program of semi-conductor development and a $250 million program to develop advanced computer software. In West Germany there is a $300 million program to develop large scale integrated circuits, financed jointly by government and industry. In France a five year integrated circuit plan costing $200 million has been developed with the goal of supplying most of that nation's needs, while in England, some $500 million has been committed to a similar development program. In Canada, he lamented, $50 million in government assistance is scheduled to be made available over the next three years, to work in the field of electronics - an area where Canada has enjoyed some modest degree of eminence in the past. He concludes:

> "Canada, already a second class nation in today's world, is on the verge of becoming a third class 'have not' nation in tomorrow's world. We are sleep walking towards technological mediocrity. We are in danger of losing control over our social and economic development in the decades, and maybe centuries to come. There is a new order emerging. In the past, the wealth of a nation depended primarily on natural resources. Canada was therefore wealthy. That is true today in some measure. But that is changing. Tomorrow wealth will depend not on resources, but on technology and on what nations do with resources. Those nations that emerge as leaders in the 21st century will be those who have seen the future and acted in the present to choose the right road.
>
> Canada is now at the fork in the road. One road leads to a position of leadership in the world of tomorrow. The other leads to insignificance. We are turning in the direction of the latter road, and seem to be shuffling aimlessly toward it."

Those are strong words, and they come from a man who has devoted his entire career to the pursuit of technology, so they may represent something of a biased viewpoint. However, Mr. Beneteau's voice is not one crying in the wilderness. He has plenty of company. And as part of this study, we have attempted to look at some of the factors involved in the national debate surrounding the concept of developing an industrial strategy for Canada as a whole and at the general issue of what can be done to reverse the relative decline in the performance of Canadian manufacturing.

Many Canadian economists, notably those at the Economic Council of Canada, the Fraser Institute and Messrs. Daly and Globerman believe that Canadian tariff policies are the underlying cause of our problems in secondary manufacturing. Their argument is that tariff policies designed to protect Canadian industry have encouraged inefficiency and the development of less than world scale plants, with short production runs sized for the Canadian market. Together, these factors are alleged to have created industries which are less than competitive in international markets.

On the other hand, over the past several years, the Science Council of Canada has published several studies outlining what that organization believes to be the key problems plaguing Canada's manufacturing industries. The Council even goes so far as to describe the decline of Canada's share of world exports of manufactured goods as a process of virtual de-industrialization of the Canadian economy.

The Science Council lays a large part of the blame on foreign ownership, which the Council believes promotes "truncated" development of our industrial structure. This truncation occurs because many Canadian companies, particularly subsidiaries of the U.S. multinationals, do not participate in all stages of product evolution, particularly in research and development. The tabulation presented at the outset of this section indicates that, with a total research and development expenditure of 0.9 per cent of gross national product, Canada is woefully behind the other industrialized nations in this respect. The Science Council explains that this weakens the long run ability of Canadian firms to be innovative and flexible and to be capable of developing new products for both domestic and world markets. Thus, by default, Canadian industry becomes more dependent on technology from other countries with the result that our industry tends to produce products at the mature end of the product life cycle rather than those in the early stages of high growth. This truncated industrial structure, it is alleged, severely reduces employment generation in the area of professional, scientific, managerial and technological skills.

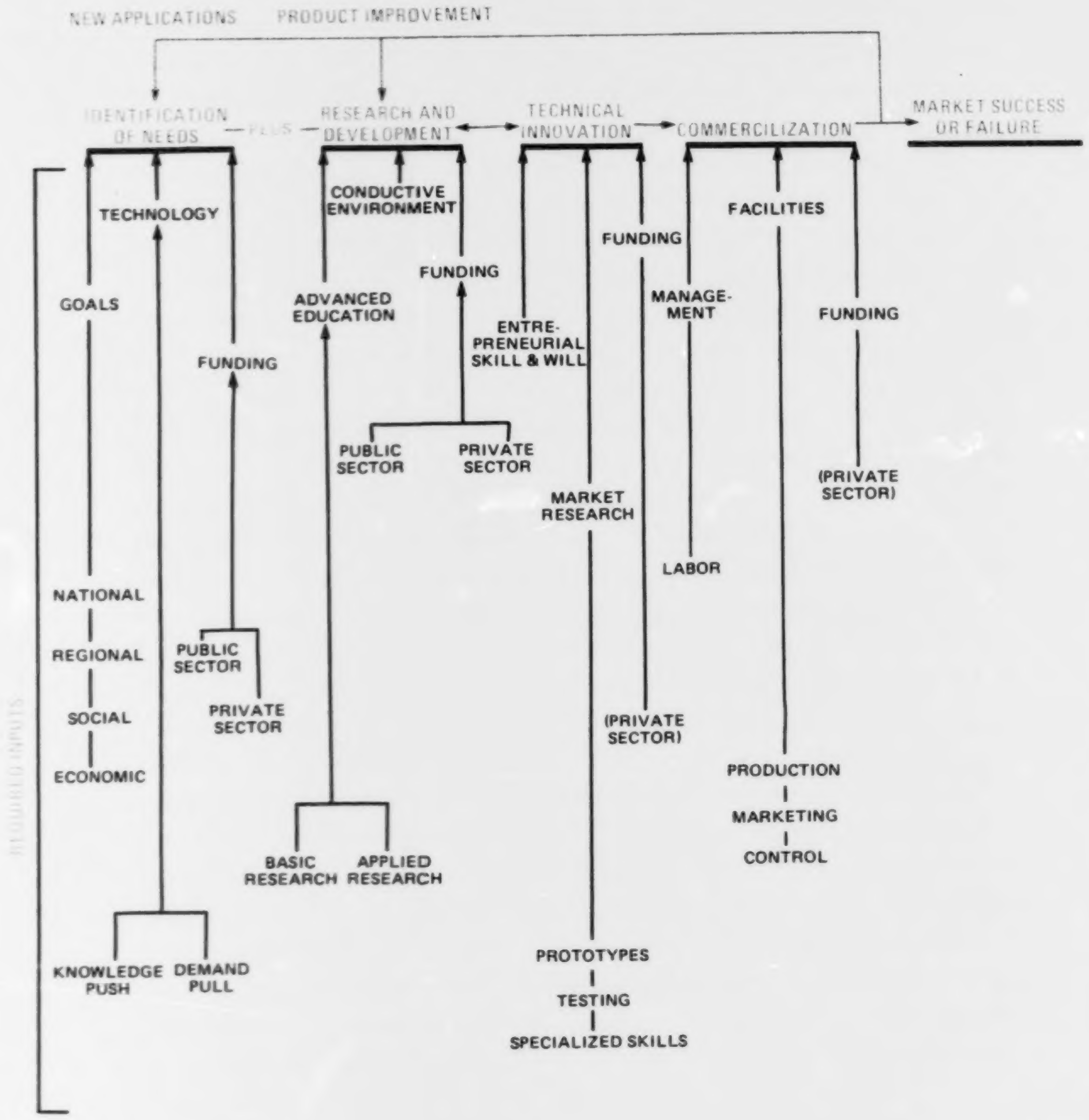
The Science Council and others have tended to view the rationalization of Canada's industrial problems as lying in the development of a national industrial strategy based on technological sovereignty - the technological capability to support national sovereignty. While the project team has not examined this possibility in great depth, we tend to agree with the views of Richard Simeon, Director of the Institute for Inter-Governmental Relations at Queen's University who has expressed the opinion that achieving agreement on any national industrial strategy is "chancey indeed" because of economic regionalism, shared federal-provincial responsibilities and the disparity in development goals across the country, not to mention all of the outside forces working on the Canadian economy. "We are much more likely to continue with a messy, complex pattern in which we do not have an industrial strategy but lots of partial, incomplete pieces of industrial strategies, federal and provincial".

However, having viewed "high technology" industry in general from both a world and a Canadian perspective, we conclude that: opportunities for regional development on a technological plane probably exist; Canada is in dire need to move in that direction; and, Alberta, in seeking ways to achieve its diversification objectives, may well have an opportunity to create a system which can effectively contribute to the well being of the nation as a whole.

3. THE HIGH TECHNOLOGY SYSTEM

The process whereby knowledge and technology-intensive industries evolve is described schematically on the following page. The high technology system illustrated therein is, in effect, a dynamic closed loop of activity, each element of which has unique inputs necessary to its performance. The diagram suggests that the proper "identification of needs" is a necessary precedent of "research and development" activity which, in turn, must successfully interact with the process of "technical innovation" before "commercialization" can occur. The arrows returning from the right side of the diagram suggest a potential re-cycling from commercial activity, either into the research and development process in terms of a requirement for product improvement, or into the needs identification section where potential new applications of commercial products might be perceived.

THE HIGH TECHNOLOGY SYSTEM



SOURCE: FOSTER RESEARCH

FIGURE 9

The diagram is, of course, simplistic and in fact may not often work in precisely the manner described. For example, activity conducted by a basic research scientist with a thirst for knowledge in some obscure university laboratory may well produce something that triggers a need identification as yet unperceived, or which requires little in the way of innovation to render it suitable for commercialization. However, it is probably reasonable to consider the system in the way that it is diagrammed, because it permits one to come to grips with the individual elements and their necessary inputs, as well as to describe the means by which the public and private sectors might work together to achieve mutually acceptable success.

The judicious application of appropriate stimuli to each of the elements of this system, can help to overcome many of the impediments to the natural growth of knowledge and technology-intensive industry from within Alberta and, at the same time, create some compelling forces which may attract such industry from beyond even Canada's borders. This process will not be achieved without additional imaginative programs being put into place and probably cannot be achieved, except over a very long timeframe, without putting some of Alberta's financial resources at risk. Based on the historical experience of other countries and the existing political philosophy in the Province, it would appear that the most appropriate and efficient role for government in this situation is to create a high technology environment, provide the stimuli and fill the gaps in the system. This should enable a broad spectrum of private sector participants to create, develop and expand over time, a range of new economic activities in response to changing market requirements. The question is - how? Some suggestions follow.

Identification Of Needs

At least in theory, this is the starting point of the innovation process whereby the requirements of society are given identification and priority. The technological needs of the Province of

Alberta have been given careful consideration by the Alberta Research Council and those, both inside and outside of government, who assisted in the development of that organization's recently-released five-year plan. Additionally, a further contribution to the process of needs identification has been made by Alberta Economic Development and Dr. H. E. Gunning, from the point of view of existing internal research activities, together with a broad study of the issues involved in the creation of effective research and development programs and the incentives which have tended to underlie such success. Finally, national requirements and the economic and social needs of the Province of Alberta have been given considerable examination during the course of this study.

The process of needs identification in Alberta has thus proceeded well. It should be emphasized, however, that this is not a stop/start situation but, rather, a continuing process, since it is dynamic. For example, there is a requirement for further examination of the needs of existing knowledge and technology-intensive industries related to research, development, expansion, market problems, etcetera. A start in this direction has been made and some ideas have been developed, but they remain tentative. A better understanding of that environment would tend to direct government initiative into other areas where there exists a reasonable probability of success in terms of attracting such industry to the Province. In such activity there should always be acceptance of the need for Alberta to strive for excellence, in order to counter the inducements of those who would compete for the attraction of the industries in question.

Education

The subject of education in this context refers to education at the post-graduate level, not only in terms of research, but also in terms of developing a supply of indigenous talent which is appropriate and oriented to the needs perceived above. In examining this question, one should accept the probability that the best educators will not waste their talent on mediocre students and that, at the post-graduate level, top students cannot be attracted except by the best educators in their chosen field of pursuit. Since Alberta cannot claim excellence at both the teacher and post-graduate student level in all areas of endeavour which will be important to the Province, the problem becomes one of where to start.

It is likely that the group most readily reachable, and those perhaps most susceptible to inducements, is at the faculty level. If the needs identification process has been properly conducted it should pinpoint those areas of most promise - be they in the field of advanced telecommunications, pharmacology, or whatever - and it is these people who should be the recipient of direct government initiative. Perhaps the creation of a series of endowed chairs in specific areas (such as was done with respect to the science of geophysics at the University of Calgary, for example) is the most acceptable route provided that the university system of allocation of support funds does not strip the talent, so attracted, of the ability to perform. Should this be considered to be a danger, it is conceivable that the physical facilities required by such "elite" groups could be part of similarly oriented research and development activities located nearby. Such an arrangement would provide the added advantage of inter-action between educators and researchers, whereby both classroom and laboratory become integrated, not only with each other, but with the process of commercial development as well.

In any event, the Government should be prepared to assess, on an ongoing basis, the responsiveness of the educational system to the application of appropriate stimuli and to adjust its policies, where necessary, to ensure satisfaction of properly identified needs. Further, the Government should consider that real excellence will likely only be achieved by concentration, not dispersion throughout the Province, of the new post-graduate activity contemplated herein. To the extent that this flies in the face of the goal of decentralization, it can probably be compensated for by taking undergraduate and technical education closer to the people through the community college and university system.

In terms of the educational requirements of the R & D process, the need for skilled technologists should not be ignored. The Province's technical schools must, in time, be prepared to supply the highly specialized talent necessary to the support of such activity, through the provision of courses of study in disciplines which may not be recognized for some time.

Research And Development

A somewhat cursory examination of the level and conduct of government-sponsored or assisted research and development programs certainly indicates serious intentions and the expectations of effective and useful results. The Alberta Research Council program is well conceived, well balanced, need-oriented and certainly in a growth mode. Indeed, indications from senior officers of the Council are that this organization is progressing at the maximum manageable rate, in terms of its five-year plan. The many other programs, such as the Alberta Oil Sands Technology and Research Authority and the Petroleum Recovery Institute, seem to be moving forward but, in some instances, probably not at the maximum rate achievable because of limitations as to funds, skills, or both.

It would appear that a prospective problem, common to most government-sponsored or assisted research and development activities, lies in the year-to-year nature of their funding. This could become dangerous, especially with the advent of major industrial research activity, in that these talents are relatively mobile and if they see serious limitations to their personal growth inherent in the system that funds them, they could well be lost and difficult to replace. While there are no simple answers to this dilemma, it is conceivable that at least certain additional programs could be amenable to longer-term commitments with respect to funding, without removing the controls which ensure that such funds are not wasted.

It is noted that current programs are oriented, in the main, toward clearly identified needs, with a major emphasis on energy research. The exception, of course, is the Alberta Heritage Foundation for Medical Research, wherein a new need was perceived and a response provided. Should the needs-identification process produce sound evidence that major initiatives can be taken in other areas of high technology - especially those with industrial application in terms of Alberta - then other opportunities to repeat that approach to funding may well arise. The result would be a clear and high profile demonstration to the rest of the world of Alberta's seriousness with respect to creating a research and development environment of excellence, oriented toward the pursuit of high technology.

The Research Council's first Five-Year Plan places considerable emphasis upon the need to draw the public and private sectors much closer togather, both in terms of joint funding and in the transfer of technology in a useful and efficient manner. The project team would concur. It should be pointed out, however, that research and development people need to be physically as close as possible to those they are trying to serve. Hence, the tendency of commercial R & D organizations to cluster around their head office centres - where the decisions are made. Decisions as to the physical location of public and private sector research and development activities should be responsive to this important requirement, as well as to the environmental and cultural requirements of the people so employed. Again, the need for excellence is emphasized.

4. THE INNOVATION/COMMERCIALIZATION PROCESS

The encouragement of advanced education and research and development activities requires support in other key areas, if it is to lead to creation of another major new area of economic activity in the Province. The end results of research and development efforts have to be directed toward market demand-oriented commercialization. The project team has considered some of the factors related to utilizing a portion of the Province's financial resources in a system to stimulate the whole process of innovation and commercialization in Alberta, because of a conviction that this is a fundamental component of this second part of an overall economic strategy.

As a starting point for developing such a strategy, the Government should become thoroughly familiar with the whole process of innovation; how it occurs; the key elements in the process; and, the most effective roles of the public and private sectors. This examination should be undertaken with full recognition of the current status of technological innovation in Canada as a whole, and with the objective of ultimately developing a strategy which is, at least partially, directed towards what is in essence a national problem - technological underdevelopment.

Historically, efforts to develop innovation through generous government support of research have often been frustrated by the failure of successful research to automatically evolve into commercial production. Britain's post-war experience in supporting research is a good example. Studies of industrial innovation and the development of new products have also demonstrated that a majority of the really significant innovation has been carried out by small companies and individual entrepreneurs. Two key additional elements seem to be essential in assuring the transformation of inventive research into commercial products. These are risk capital and scientists with an entrepreneurial drive, or at least entrepreneurs who can relate to scientists.

In this study the project team was seeking ways in which to employ the results of such research activity as an instrument of economic policy - specifically to exploit strengths in a way which will diversify Alberta's economy in the direction of knowledge and technology-intensive industries, and to do so in a major way. Normal market forces cannot be depended upon, in a regional situation such as Alberta, to accomplish this except over the very long run. The project team therefore commends to the Government of Alberta a quasi-interventionist approach - certainly not "Japan, Inc." but rather, the creation of a unique system of financial stimulation to the process of innovation and commercialization.

A Major Financial Stimulus - Venture Capital

Risk capital, popularly known as venture capital, is the seed money used to get an idea started, or to help it through critical points in its development. It is usually required before conventional debt financing becomes a possibility for a new enterprise. Traditionally, venture capital has come from a variety of sources - from wealthy individuals and families; from professional groups; and, from venture capital investment companies.

Venture capital, because it usually takes the form of equity financing, involves the risk of total loss. However, on the other side of the equation very significant capital gains have been generated by ventures which succeed.

In Canada, a major weakness is a shortage, even in relative terms, of venture capital as compared to the United States.

Why Should Alberta Consider Venture Capital To Be A Potentially Important Element In The Province's Economic Strategy?

(a) It is one major instrument which can be used to attract and stimulate the process of innovation within the Province and to transform, into successful commercial applications, research disoveries which can be expected to flow from R & D expenditures.

(b) It can be used to attract to Alberta, entrepreneurs from the world-wide scientific and technical community, thus helping the Province to exploit the fall-out from research and development done elsewhere. The development of the microelectronics industry in California is a good example of this process, where small groups of scientists and engineers have left major companies; obtained venture capital to finance a new idea; and, formed a new company to capitalize on the value of the innovation process. Conceivably, some of this type of spin-off could be attracted to Alberta.

(c) The availability of venture capital on a significant scale in Alberta would also help with the exploitation of fallout from research and development done within Alberta. Chembiomed Ltd., the recently formed pharmaceutical company at the University of Alberta is a good example of research, carried out in Alberta, that has resulted in the successful commercial application of a research discovery. It is now at the stage where substantial venture capital financing may be required, if it is ever to reach its full potential.

(d) There is presently intense competition, throughout the industrialized world, to attract high technology industry. The availability of venture capital in Alberta could give the Province an early advantage in the case of embryonic industries.

(e) An examination of the U.S. microelectronics industry indicated that there is currently a significant shortage of venture capital available to new companies in that industry. This could represent a significant opportunity, if Alberta chose to attract high technology development in this field.

(f) A supply of venture capital provides the opportunity to mobilize new ideas at their inception, instead of relying on costly incentives, directed at attracting industries once they have developed in other areas.

(g) Venture capital represents a form of government investment which, in the event of success, can be readily transferred to private ownership, to the ultimate benefit of both the public and private sectors.

(h) A small proportion of Alberta's financial resources could conceivably have a major long-term impact on the Provincial economy, because of the leverage provided by using the venture capital system in the manner contemplated.

Why Will Dependence On Private Sector Venture Capital Companies Not Be Effective?

(a) Almost all Canadian venture capital companies are too small to be effective, consistent suppliers of venture capital at all stages of need.

(b) Few can handle situations requiring even one million dollars of start-up capital, often a threshold level for significant innovation.

(c) Few are of sufficient size to possess the diversified investment portfolios which enables participation in the high potential (high risk) opportunities at an acceptable level of risk, overall. The Small Business Investment Corporation's (SBIC's) in the U.S. are frequently so small they really cannot take risks at all - so they end up as expensive lenders, rather than venture capitalists.

As a result of the foregoing, the project team has concluded that it is unlikely that the private sector will be capable of assembling the pool of venture capital required to attract the innovation process to the Province in a major way, nor to support significant new ventures through several stages of financing. Therefore, if the process of innovation is going to develop in Alberta and create a significant impact, it probably must be funded from a substantial capital pool such as is present in the AHSTF.

There remains, however, the critical question:

> How can government funds be used to create a vehicle which effectively acts like a private sector venture capital company?

Various approaches have been used in other countries. The United States has coupled government funds with private funds in its SBIC program. However, as mentioned on the preceding page, they are not particularly well suited to achieving the kind of objectives which Alberta might have.

Many industrialized countries have some mechanism for encouraging venture capital enterprise. However, only a few, such as the Government of Great Britain have provided resources on a scale capable of having a substantial impact on national innovation. In Britain, the Labour Government established a special structure within the National Enterprise Board to channel public funds into equity interests in new, high technology ventures. Despite some problems with this approach, it is noted that the Conservative Government in Britain has decided to actively pursue this course of action, albeit with some amendments.

An economic strategy directed towards diversifying the Alberta economy away from a dependence on the energy sector should include some thrust toward fostering the technological innovation process within the Province. Thus, the project team suggests that the Government examine in more detail the successful approaches followed in other countries with respect to utilization of public funds for venture capital purposes and, in addition, assess alternative institutional or system designs to determine what will precisely fit Alberta's particular requirements.

A Conceptual Framework

The schematic diagram on Figure 10 following, outlines one conceptual framework for the development of a major venture capital system in Alberta. The suggested structure hopefully would achieve three main objectives:

(a) to utilize part of the AHSTF to stimulate the process of technological innovation within Alberta;

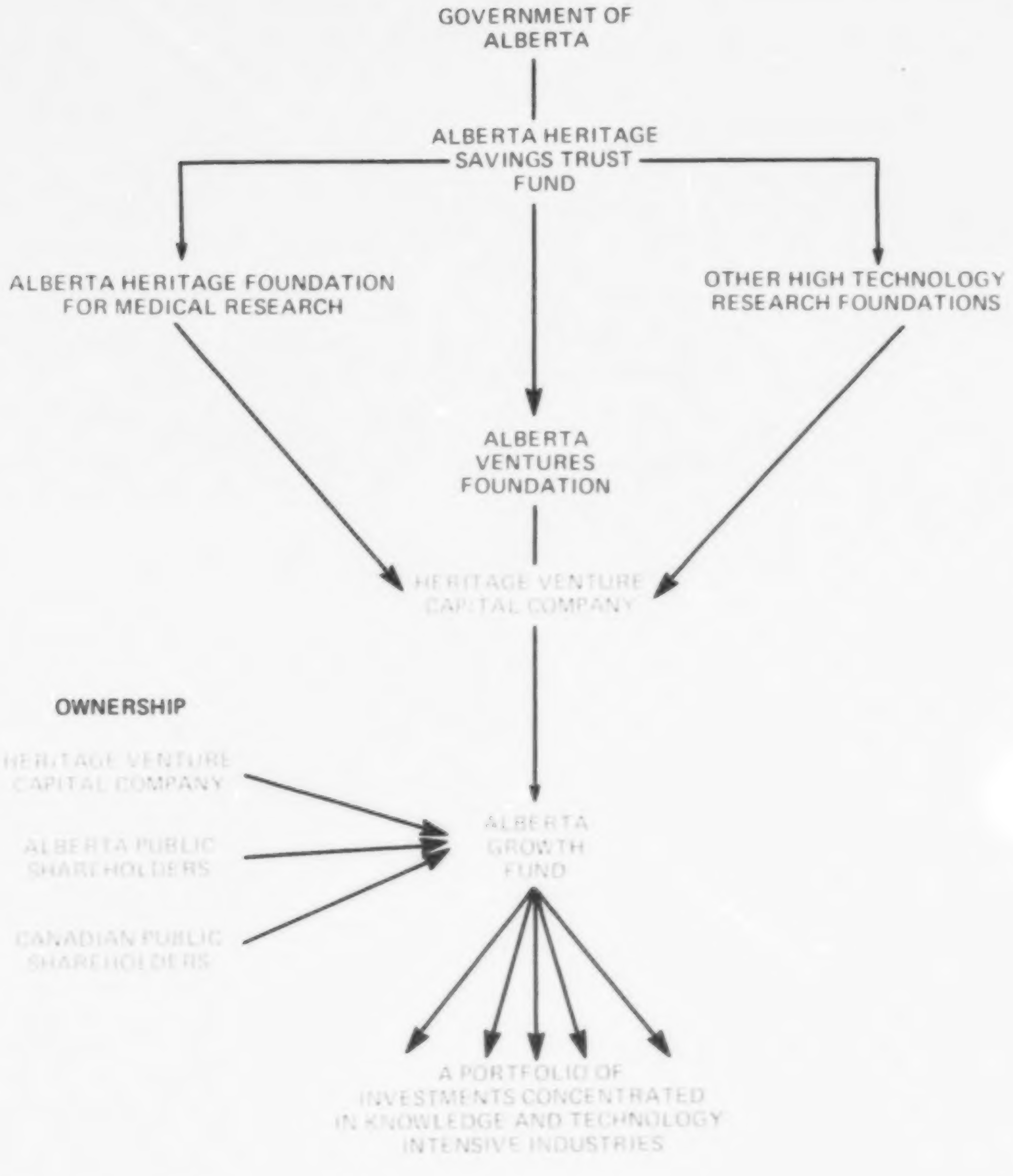
(b) to create a mechanism whereby the ownership of successful ventures could be transferred to the private sector - particularly to Albertans, whose funds in part gave rise to such success; and,

(c) to respond to the political realities associated with the commitment of public funds to direct support of the private sector, in a way which involves equity participation and risk.

Some comments on the schematic diagram are undoubtedly necessary.

First, the question of risk must be addressed. What could be more risky than investing a significant portion of the AHSTF in basic research in the field of medicine, where the prospects of individual failure are enormous. The answer, of course, is that the principal endowment in the Alberta Medical Research Foundation is not, itself, at risk - only the earnings therefrom are in such a position. It would seem reasonable that a similar approach could be taken with an "Alberta Ventures Foundation". An endowment, for example, of $500 million would have the ongoing capacity to pump more than $50 million per year into the innovation system as opportunities presented themselves and would make the Foundation's operating arm (herein called the "Heritage Venture Capital Company") by far the largest venture capital company in Canada and place it among the larger of such organizations in the world. While it would be important to commit the endowment to enable the system to attain early international recognition, it would not be necessary to actually allocate funds to the Foundation until they were required.

A CONCEPTUAL FRAMEWORK FOR A MAJOR VENTURE CAPITAL SYSTEM


GOVERNMENT OF ALBERTA
ALBERTA HERITAGE SAVINGS TRUST FUND
ALBERTA HERITAGE FOUNDATION FOR MEDICAL RESEARCH
OTHER HIGH TECHNOLOGY RESEARCH FOUNDATIONS
ALBERTA VENTURES FOUNDATION
HERITAGE VENTURE CAPITAL COMPANY
OWNERSHIP
HERITAGE VENTURE CAPITAL COMPANY
ALBERTA PUBLIC SHAREHOLDERS
CANADIAN PUBLIC SHAREHOLDERS
ALBERTA GROWTH FUND
A PORTFOLIO OF INVESTMENTS CONCENTRATED IN KNOWLEDGE AND TECHNOLOGY INTENSIVE INDUSTRIES

SOURCE: FOSTER RESEARCH

FIGURE 10

The existence of such a system, on an ongoing basis, should enable attraction of the finest venture capital managers and provide an analytical staff par excellence, while leaving substantially intact the pool of venture funds available for investment in projects which meet the eligibility criteria. These criteria, in turn, would be generally reflective of the Government's economic strategy.

The Foundation and the Heritage Venture Capital Company would provide the insulation between equity ownership and the governmental process, if it were structured in an appropriate manner. The entrepreneur would not be fearful of political intervention in such a situation, nor could the government reasonably be held responsible for entrepreneurial failure, any more than would be the case with respect to the failure of a specific medical research project. Matters relating to the performance of management would be the responsibility of the Board of Governors of the Foundation and the question of accountability to the Legislature would appear to be no more complex than is the case with respect to the Medical Research Foundation.

The Heritage Venture Capital company would have the magnitude and profile to attract entrepreneurs to Alberta from the world-wide scientific and technical community and to stimulate the process of technological innovation in the Province. This organization would screen and evaluate proposals, then have the financial capability to provide several stages of equity financing. The company would also provide management and other support services to new companies, as is done by many companies in the conventional venture capital industry.

As successful ventures reach a certain point of maturity, they could be sold to the Alberta Growth Fund, or alternatively, into the public market. Creation of the Alberta Growth Fund is thus not an essential facet of venture capital supply. However, its establishment could add significant dimensions to the system. The Fund, with majority private ownership, provides one opportunity to transfer successful ventures to the private sector. It also represents an investment vehicle which would allow a broad spectrum of individual Albertans and other Canadians to participate, in a well-diversified manner, in the financial returns generated by the innovation process and the successful new businesses, which would evolve partially as a result of the investment of public money.

Initially, the Fund could purchase interests in selected and appropriate Canadian high technology companies to form a core portfolio. Such activity would create a marketable investment and, in addition, help to publicize the entire program, thus enhancing its national and international profile. However, the Fund could also serve as the resident Alberta partner in joint ventures with existing, foreign high technology companies, who choose to locate in Alberta because of other factors.

IN SUMMARY

In summary, Alberta's economic prospects for the next fifteen years appear to be bright. However, they are dependent on the occurrence of certain development sequences within the energy industries sector in the Province. If major new natural resource development proceeds with its billions of dollars of direct capital investment and spinoff activities, the overall rate of economic growth in Alberta should be higher than that experienced by Canada as a whole or the United States during 1980-1995. This growth will be dependent, to a significant extent, on real relative increases in energy prices over the forecast period. One obvious challenge facing provincial economic policy-makers will be to influence the national energy situation in such a way that Alberta's conventional oil and gas and oil sands resources may be developed at a pace and at a value compatible with both the provincial and the national interest.

The second challenge is much less defined, involves a greater degree of uncertainty, and is perhaps even more difficult to achieve. That challenge is to build upon the foundations of the Province's existing economic strengths and to develop a strategy which, over the long run, will lead to real and significant diversification of the Alberta economy. Thus, it is hoped, new areas of economic activity could be in place when the energy industries begin to decline in importance. Alberta has both the financial resources and the lead time necessary to pursue a strategy based on stimulating the very "grass roots" of economic growth and concentrating on the export oriented, high growth, knowledge and technology intensive industries of the future. It is these types of industries which will represent a key component of economic growth in the major industrialized countries of the world during the next several decades. This strategy requires a ten to twenty year planning horizon, the sponsorship of the right educational and research and development environment, the recognition that Alberta would be competing with the rest of the highly industrialized world, and the political courage associated with the major re-deployment of public assets.

The scaling up of the Province's commitment to higher education, major support to research and development, and the establishment of a mechanism for the transfer of some of the Province's financial resources for investment by the private sector, are the key components of the suggested strategy.

This is a long term strategy and, if pursued with sufficient commitment, should provide the economic expansion necessary to sustain the high standard of living now enjoyed by Albertans.

VOLUME I

APPENDIX A

SUMMARY OF VOLUME II

VOLUME I

Appendix A

THE GLOBAL ECONOMIC AND POLITICAL ENVIRONMENT AND ITS IMPACTS ON ALBERTA: 1980-1995

A SUMMARY OF VOLUME II

A. GLOBAL ENVIRONMENT

1. WORLD POLITICAL OUTLOOK

(a) The 1980s promise to be the most perilous decade since the peak of the Cold War. The early 1980s will be particularly dangerous because of the ongoing buildup of Soviet military capabilities and the political and social tensions in the Middle East.

(b) International politics will continue to be dominated by the relationship between the United States and the Soviet Union. There will be no substantial amelioration of tensions between the two super powers.

- U.S.-Soviet relations have been deteriorating since the 1972 Moscow summit at which the first SALT accords were signed. Since then, neither the American hopes for a restrained Soviet military posture nor the Russian hopes for improved access to U.S. technology and favourable loan treatment have been realized.

- The balance of strategic and conventional military power has shifted in favour of the Soviet Union. The momentum of current programs will increase the Soviet advantage throughout the early 1980s. U.S. efforts to counter this shift in power will not have appreciable effect until the mid-1990s at best. However, a consensus appears to be building in the West that the Soviet challenge must be met, and most of the European members of NATO have joined the United States in pledging to strengthen their military capabilities.

(c) The Middle East will remain volatile. Continuing sources of tension will be: Soviet adventurism; the Arab-Israeli conflict; the internal fragility of many regimes; traditional-radical splits within the Arab world; regional rivalries; massive transfers of sophisticated armaments; terrorist activity; and the regional potential for nuclear weapon proliferation. Thus as western oil dependence grows, Soviet influence continues to increase in the region; and internal political stability in some countries deteriorates, interruptions in oil supplies must be anticipated.

(d) Potential for armed conflict is considerable elsewhere -- the Indian sub-continent, Africa, and Latin America. In some cases there may be clashes between client states of the superpowers, but escalation to a major conflict between the superpowers is unlikely. Soviet support for "national liberation" movements in the Third World, however, will be a continuing concern, particularly in Southwest Asia, Africa South-of-the-Sahara, Central America, and the Caribbean.

(e) The outlook for political and military stability in East Asia in the next 15 years is rather favourable. Growing co-operation among Washington, Tokyo, and Beijing in an effort to contain the Soviet-Vietnamese alignment is expected. Both Japan and China are likely to modernize their conventional military forces with U.S. approval and support. Sufficient strategic and political stability to permit continued economic development, especially among the Association of Southeast Asian Nations (ASEAN), is probable.

(f) Calls for a new international economic order will continue to serve as a rallying point for Third World countries, but the cohesion of these countries is fragile due to their disparate political, economic, and social characteristics. The newly industrializing countries and other rapidly developing or comparatively well-endowed Third World countries will increasingly view their interests as requiring closer ties to the developed countries.

2. WORLD ECONOMIC OUTLOOK

(a) World economic growth in the 1980-95 years will be moderate at best in most countries. The growth rate of real world Gross National Product (GNP) will be well below the level achieved during the rapid growth period of 1950 to 1973.

- Real economic growth in the United States in 1980-95 will average about 3.0% per year, somewhat below the 3.4% per year long-term post-war average.

- The Japanese economy will grow at a 4.7% rate in real terms in 1980-95. The abrupt transition from 10% annual growth in the 1950s and 1960s to growth rates half that level in recent years has forced a shift to a greater emphasis on generating internal demand rather than export-led growth.

- Average real economic growth in Western Europe will be about 3.0% per year in 1980-95, compared with 5.0% in the 1950-73 period. The perception of economic malaise that has pervaded Europe since 1974 will continue in the 1980s.

- The most rapidly growing economies will be those of the newly industrializing countries -- Korea, Taiwan, Hong Kong, Singapore, Mexico, Brazil, Portugal, Spain, Greece, and a few others. Their growth strategies will emphasize the export of basic manufactured goods such as textiles, footwear, steel, and electrical products.

- Most of the lower income less developed countries will face very serious economic difficulties, compounded by weak export markets and high oil import costs.

(b) The fundamental sources of long term economic growth -- increases in the labour supply, capital investment, improved technology, better management, and economies of scale -- will still be operative in the future. These forces, however, will be hampered substantially by a number of basic problems that will cause considerable difficulties for almost every country at various times in the next 15 years.

- Inflation will remain an almost constant concern in most developed countries. Only Germany and Switzerland are likely to have average inflation rates of less than 5% per year in the next decade and a half. Canada and the United States will struggle to bring inflation down to the 6% - 7% range, while the U.K., France and Italy will have difficulty keeping their inflation rates below 10%.

- Unemployment will likewise remain a major concern. The problem will be particularly severe in Western Europe where unemployment rates will be several times as great as in the 1950s and 1960s (although slightly lower than current levels).

- Balance of payments problems will occasionally affect individual developed countries, but will not be a decade-long problem of the magnitude of inflation and unemployment. Some less developed countries, however, will face almost permanent balance of payments crises.

- Governments will become even more active in economic management than before, although this will take the form of government ownership of enterprise less frequently than in the past. Governments will increasingly offer tax incentives and employment subsidies to private business.

- The international monetary system will continue to be a shifting amalgam of managed exchange rates and moderate constraints on international capital flows. Large financial surpluses built up by the OPEC countries as a result of high oil prices will be a destabilizing force in international markets, but no breakdown in the system is anticipated.

(c) Energy will continue to be a major preoccupation for every country in the world.

- The crux of the energy problem is uncertainty over the cost and security of supply of oil. Political instability in the Middle East and the potential for further chaos in Iran and several other OPEC countries create a significant chance of periodic supply interruptions and price jumps.

- The average annual rate of increase of oil prices in the 1980-95 period is expected to be about 2% greater than the world inflation rate. But oil price changes are not likely to be uniform year-to-year; they will probably follow the pattern of the past five years -- infrequent large increases followed by periods of moderate change. This pattern will continue to create a semi-crisis atmosphere in the oil importing countries and will be an important factor in international relations.

(d) The availability and cost of non-energy raw materials will not be a major problem. For most minerals adequate supplies exist and are available from a variety of sources. Effective cartels with substantial control over prices are unlikely. Prices on world markets will continue to fluctuate considerably but on average will not increase much faster than prices in general over the next 15 years. A few relatively minor minerals which are produced primarily in politically unstable areas, such as chromium and cobalt, may be subject to supply interruptions or sustained price surges.

(e) World food supplies are generally expected to be adequate to feed a growing world population. However, a number of very poor countries will not be self-sufficient in food production and will require international assistance. Improving diets in the higher income developing countries may lead to greater import demand for some agricultural products, including wheat.

B. IMPLICATIONS FOR CANADA

(a) Because future economic growth in Western Europe and Japan will be much less vigorous than during most of the post-war period, European and Japanese businessmen and investors will increasingly look outside their countries for investment opportunities. The less developed countries will be major recipients of capital flows from Europe and Japan, but several industrialized countries -- including Canada, the United States, and Australia -- will also be attractive. The Europeans and Japanese may be particularly interested in investments in resource-related areas.

(b) Modest growth prospects in the industrialized countries, plus a gradual shift of basic manufacturing to the less developed countries (LDCs), lead many countries to pursue high technology industries as a source of future growth. Thus competition will be fierce among countries and regions to attract companies already active in these industries and to support high technology research and development.

(c) The combination of modest economic growth and intractable problems such as energy costs and availability, inflation, unemployment, balance of payment deficits, and intense export competition will increasingly politicize international economic relations.

- Trade protectionism will probably become more prevalent. Following the pattern of recent years, this will consist largely of temporary import quotas and voluntary export restraints. The overall impact of such measures will be relatively minor, but disruptions of trade in some products could be a significant problem for some countries. Despite the movement toward more controlled trade relations, however, a reversal of the post-war trend toward lower tariff levels worldwide is unlikely.

- Although the overall global balance between the supply of and demand for food is expected to be adequate, a number of very poor developing countries will be unable to meet their own food needs and will not be able to afford to import sufficient food supplies. Food exports may become an increasingly visible issue in the international arena and pressures may grow for greater volumes of concessionary food shipments by the major exporters of agricultural commodities.

(d) Because of its favourable political and economic outlook, East Asia will be increasingly important to Alberta and the rest of Canada. Export opportunities for raw materials to resource-poor countries such as Japan, South Korea, Hong Kong, Taiwan, and Singapore will expand. The demand for Canadian agricultural exports will also increase as living standards improve in the region. Canada may also benefit as a gateway to the North American market for East Asian exports.

(e) Political and economic links between Canada and the United States will remain very close. However, the growing importance of Mexico to the United States will alter the nature of Canada-U.S. relations.

- The United States will purchase increasing amounts of oil and gas from Mexico in order to reduce its dependence on energy imports from less reliable countries, and will seek co-operation from Mexico in countering Marxist insurgency movements in Latin America. Mexico will seek greater access of its agricultural and industrial exports to the United States, and will push for a more liberal U.S. immigration policy to relieve some of its population and unemployment pressures.

- Mexico's increasing importance to the United States will complicate the special U.S.-Canadian relationship. The United States will be forced to display an even-handed policy towards its neighbours to the north and south.

C. CANADIAN ECONOMIC AND POLITICAL OUTLOOK

(a) The Canadian economy will experience moderate growth in the 1980-95 period. Real GNP is expected to grow at an average rate of about 3.5% per year, somewhat more rapid than during the past five years but considerably slower than the robust growth experienced in the 1950s, 1960s, and early 1970s.

(b) Inflation and unemployment are likely to remain major concerns throughout the period. Unemployment, which averaged 5.0% per year in the 1960-73 period and 6.6% per year in 1974-78, is expected to average almost 7.0% in the next 15 years. Inflation will slowly recede from current levels, but will still average about 7.0% in 1980-95.

(c) The balance of payments will also be a significant constraint on the economy well into the 1980s.

- The merchandise trade surpluses of the past may be even more favourable in the future in response to both stronger world demand for resources and to the weakening of the Canadian dollar that has occurred during the past two years. However, the deficit on services, which in 1978 was twice as large as the surplus on trade, may worsen.

- Debt service has become a large and growing deficit item and is likely to increase in the future.

- Private capital flows have also become problematical. Canadian investment abroad is rising rapidly, partially reflecting uncertainty with Federal government policies, the national deficit and the status of the Canadian dollar. Foreign investment in Canada is expanding less rapidly than in the past, because of Canadian takeovers and the uncertain economic and political outlook. However, the deterioration of the capital flow balance that has occurred in recent years may be at least partially reversed in the 1980s by sizeable inflows of foreign capital to help finance major energy projects.

- The Canadian government and Canadian enterprises have favourable access to foreign capital markets and should be able to finance even somewhat larger deficits on current accounts during the next several years, if necessary. However, a continuation of the trend toward ever-increasing payments deficits may lead to reluctance on the part of foreign lenders to continue to supply capital on favourable terms.

- Federal policies are expected to be aimed at preventing greater deterioration in the balance of payments. This generally implies encouraging wage restraint and peaceful labour relations and otherwise seeking to encourage the expansion of private investments and to limit inflation rates to U.S. levels or lower. Emphasis will also be placed on encouraging exports and expediting large energy projects expected to attract foreign funding. Exports of gas and electricity may be expanded if balance of payments pressures remain severe.

(d) Exchange rate policy will seek to stabilize the value of the Canadian dollar at present levels and to counter speculative movements associated with the uncertainties of large capital projects. If adequate stability is not restored to the long-term balance of payments, however, exchange rates will be allowed to drift downward.

(e) Inflationary pressures, balance of payments deficits, and commitments to restructuring federal-provincial relations will limit major federal initiatives in expenditure or tax changes. Federal budgets are likely to continue to be in deficit for some years, only partially offset by provincial surpluses.

(f) Domestic and foreign trade barriers will be gradually reduced over the next ten years. Trade barriers erected to protect labour intensive industries from foreign competition will be gradually phased out, and will be replaced by adjustment assistance to depressed geographical regions.

(g) The issue of federal-provincial relations will be periodically bargained over and modified but never fully resolved.

- The threat of economic and political fragmentation of Canada raised by Quebec nationalist aspirations and by federal-provincial differences over resource revenues may continue.

- The forthcoming election in Quebec should focus public attention on practical solutions to the issue of Quebec separatism as the seriousness of the consequences of not solving the problem becomes more immediate. As a result, some compromises should begin to emerge relatively soon after the elections.

- Over the next two or three years changes in federal-provincial relations may enhance provincial authority and involvement in activities previously largely under federal control.

- As a result of these changes in federal-provincial relations, federal policies and regulations will be modified in ways that will partially accommodate long-standing economic concerns of the western provinces vis-a-vis the eastern part of the country.

VOLUME I
APPENDIX B

SUMMARY OF VOLUME III

Appendix B

THE ALBERTA ECONOMY

A SUMMARY OF VOLUME III

PRIMARY RESOURCE SECTOR PROFILES (CHAPTER III)

A. AGRICULTURE

1. PRIMARY AGRICULTURE

Inputs

- The total number of farms will continue to decrease but more slowly.
- Larger farms (760 acres plus) will grow in numbers.
- There will be significant numbers of small farmers working part-time or full-time while maintaining their farms.
- Adjustment problems for those leaving agriculture are expected to be minimal because of the general buoyancy of the economy.

Outputs

- The physical potential of the agricultural land base is considerably under-utilized because it is not economic to bring additional land into production.
- Summerfallow acreage (currently the largest single use of improved land) will likely decline as more land is cropped continuously.

- Expansion of irrigated land may not be warranted if most of this land is used to grow grains and forage crops. It could be warranted if a high percentage of expansion lands were used to grow crops which require irrigation, such as vegetables and sugar beets.

- The three dominant crops, wheat, barley and rapeseed will contribute to the bulk of income from crops.

- Cattle and calves will remain the dominant source of income from livestock, while income from hogs will increase as their numbers grow.

- Other crops, dairy, poultry and sheep will grow with the Alberta market but will not likely increase their relative contributions to agricultural incomes significantly.

Markets

- The rapidly growing Alberta market will not be insignificant, but viability and growth of agriculture will be determined in export markets.

- Wheat, barley and rapeseed account for roughly 80 per cent of all crop exports and are likely to remain this dominant.

- Beef and veal account for roughly 70 per cent of all livestock exports and are likely to remain this dominant.

- Without a breakthrough, the expansion of exports will continue to occur largely in raw, unprocessed form.

- Any growth of processed agricultural crop export markets is likely to be steady rather than spectacular, so initial development of these markets should be continued.

Opportunities And Constraints

- Marketing is the fundamental constraint to growth of agriculture in Alberta. Constraints to increased marketing include: high production costs because of climate; a historical emphasis on production; lack of a private sector marketing force of brokers, middlemen and intermediaries; and, limitations to the marketing role that government can perform.

- Low statutory rates on grain shipments have adversely affected the capacity of the railway transportation system and the grain handling system. Compensatory rates are expected during the next 10 to 15 years and will result in increased exports, although major increases in transportation capacity will take some years. (Steps taken to date include support for the Prince Rupert Terminal project, major hopper car purchases and the Alberta Grain Terminal initiative.)

- Agriculture in Alberta is more constrained by climate than by a lack of arable land.

- Research should be directed toward the fundamental constraints of marketing, transportation and climate and the opportunities presented by large areas of unimproved land.

- Large tracts of new land are unlikely to be brought into production.

- Considerable rehabilitation of existing irrigation systems, drainage and saline water disposal schemes will have to be undertaken.

- Economics are unlikely to warrant widespread improvement of the approximately 1,000,000 acres of solonetz soils estimated to be economically improvable by deep plowing.

- Residential, transportation and industrial growth, salinity and erosion are all encroaching on the agricultural land base. Some of these are irreversible.

- A generally buoyant economy will make competent hired farm labour and managerial talent difficult to attract.

- High costs of land and machinery and low cash flows are financial constraints facing farmers.

2. AGRICULTURAL PRODUCT PROCESSING

- The levels of livestock slaughtering will depend on supplies of animals on feed and available for slaughter. Supplies of cattle are expected to increase, in part due to a move to compensatory freight rates.

- Alberta beef is expected to maintain its position in the Montreal market.

- Hog slaughtering will increase steadily.

- Poultry processing will increase over the next 10 to 15 years in response to growth of existing markets.

- Growth of rapeseed crushing will depend on the resolution of transportation cost differentials and international demands for oils.

- Sugar beet, vegetable and alfalfa processing are expected to grow but only in response to increased demands in existing markets.

B. ALBERTA'S FOREST RESOURCES AND THEIR DEVELOPMENT

1. FOREST RESOURCES

- Alberta is richly endowed with forests. Approximately 98 per cent of Alberta's forest land is owned by the Province, and 75 per cent of timbered land is north of Township 60. About 54 billion cubic feet of all species growing on public land are available for commercial production.

2. STRUCTURE OF THE FOREST INDUSTRY IN ALBERTA

- Coniferous lumber and plywood logs, and pulpwood account for about 90 per cent of value of annual Alberta timber products production. The Alberta forest industry, third in size in Canada after British Columbia and Ontario, employs about 7,800 persons to cut and process timber production.

- Approximately half of Alberta's lumber is exported and of the remaining 50 per cent, half finds its way to markets in provinces other than Alberta. Total production in 1979 was about 740 million fbm.

- Alberta pulpwood production has increased from about 379,000 cords in the year 1966-1967 to approximately 643,000 cords in 1978-1979. It is currently used to produce pulp (but not paper).

- It is estimated that 90 per cent of Alberta pulp is marketed in the United States and 10 per cent in Canada.

3. STRENGTHS AND WEAKNESSES OF THE ALBERTA FOREST PRODUCTS INDUSTRIES

Strengths

- Alberta has very sizeable uncommitted volumes of both softwood and hardwood timber reserves. Hardwood species have not been utilized to any significant degree, but the main hardwood species, aspen, is an important commercial species in some pulp-producing areas of the United States.

- Alberta's softwood costs are the lowest in Canada. Also, in general, Alberta's softwood trees are larger than those found in Ontario and Quebec, providing a competitive advantage for some uses.

- Alberta spruce and pine are a particularly desirable raw material for bleached kraft pulp.

Weaknesses

- Alberta producers are heavily dependent on export markets and, therefore, have very little control over product prices received.

- Because of its geographical location, the Alberta industry's transportation costs to much of its market are higher than those faced by competitors.

- Alberta's forests are relatively slow growing in comparison to those of many competitors.

4. OUTLOOK FOR ALBERTA LUMBER AND PULP, 1980-1995

Potential Alberta Timber Reserves Suitable For New Sawmill Or Pulp Mill Developments

- Alberta's forest reserves are estimated to be large enough to support an annual cut, on a sustained yield basis, that is five to six times present levels.

- A number of locations with potential for sizeable new sawmill and/or pulp mill developments have been identified.

Demand Outlook For Alberta Lumber

- Canadian requirements for Alberta lumber are projected to grow from 395 million fbm in 1980 to 990 million fbm in 1995.

- Exports of Alberta lumber are expected to increase from 390 million fbm in 1980 to a peak of 790 million fbm in 1991, dropping off to 590 million fbm by 1995. The projected decline is attributed to an expected age group imbalance in standing timber, which would limit total production available for export.

- The total projected growth in lumber production is equivalent to construction of about five 100 million fbm/year sawmills between 1980 and 1987, one similar sized new mill annually during 1988 to 1991 and no mills in the 1992 to 1995 period.

Potential Growth In Alberta Pulp Industry - 1980-1995

- Alberta pulp production is projected to increase from 450,000 tons per year in 1980 to 1,225,000 tons per year in 1995.

- Specific pulp developments expected are the British Columbia Forest Products, 175,000 tons per year facility to be operational at Whitecourt by 1986; an expansion from 250,000 tons per year to 500,000 tons per year of Proctor & Gamble's Grande Prairie mill by 1989; and, commencement of operation of a 1,000 ton per day mill in the Athabasca area. Additional mills may be built prior to 1995.

5. NEED TO EXTEND FOREST MANAGEMENT RESEARCH IN ALBERTA

- Within the Canadian scene, Alberta is considered to be above average in forest management practices. However, most forestry research is carried out by the Federal Government, primarily through the Canadian Forestry Service which has been faced with a declining budget during recent years.

- Increased harvesting of Alberta's vast timber resources, on a sustained yield basis, should be encouraged for a number of reasons, including the fact that forests not harvested at maturity deteriorate and real economic loss is suffered. Secondly, greater development of forest resources will have a favourable economic impact on more remote areas of the Province, thereby reducing dependence on non-renewable resources and contributing to balanced economic growth.

- More provincially funded research, both basic and applied, is essential, with emphasis on aspen utilization and silvicultural and forest management practices designed to reduce the length of the growing cycle. The Alberta Government should establish a northern Alberta forest research station to undertake aspen utilization research together with other studies involving subjects such as propagation of hardwood and softwood species and biomass.

C. ENERGY INDUSTRIES

- Alberta's "mining" sector (as defined in the public accounts) consists of industrial activity related to the extraction and separation, from extraneous material, of the Province's mineral resources. These resources include conventionally produced petroleum, natural gas and natural gas by products; synthetic crude oil derived from the processing of crude bitumen extracted from Alberta's oil sands; unconventionally produced heavy oils; sub-bituminous coal; several non-metallic minerals including limestone, shale, sand and gravel and minor quantities of salt. Due to the sedimentary nature of most of Alberta's geology, there is no metallic mineral production, although there exists a major, sub-commercial grade iron ore body and trace amounts of other metals, particularly in the Athabasca area oil sands.

1. CONVENTIONAL OIL AND GAS

Crude Oil And Its Equivalent

- Deliveries of crude oil and its equivalent (excluding synthetic crude oil) began to decline during the 1970s:

Alberta Crude Oil And Equivalent Deliveries

	1970	1972	1974	1976	1978
			(Millions of Barrels)		
Total Deliveries	367	480	556	429	422

- The trend towards declining deliveries has been overwhelmed by rising prices:

	1970	1972	1974	1976	1978
			(Billions of Dollars)		
Value of Production	1.0	1.4	3.2	3.7	5.2

- At the end of 1978, the ERCB estimates of remaining established reserves stood at 5.0 billion barrels of conventional crude oil and 1.5 billion barrels of condensate and pentanes plus.

- The ERCB projects that approximately three billion barrels of conventional crude and its equivalent will be added to proved reserves during the period 1979 to 1995, before allowance for production during that period.

- Production will decline rapidly over the same 1980 to 1995 period with daily production in 1995 being only about 50 per cent of the projected 1980 production of 1,250,000 barrels per day.

- At the end of 1995 the ERCB estimates remaining proved reserves of conventional crude oil and its equivalent will be just in excess of 3.0 billion barrels.

Natural Gas

- During recent years, the natural gas sector of Alberta's petroleum industry has experienced dynamic growth, with annual deliveries increasing from 1.27 Tcf in 1969 to 2.13 Tcf in 1978.

- In early 1979 the ERCB increased its estimate of ultimate potential natural gas reserves from 110 trillion cubic feet to between 130 to 140 Tcf, with the provision that if prices go well beyond those anticipated or if major technological breakthroughs occur, the ultimate potential could increase to perhaps in excess of 200 Tcf.

- By the end of 1978, 85 Tcf of Alberta's gas reserves had been established, approximately 50 Tcf were yet to be found and 26 Tcf had been produced.

- Several profiles of projected natural gas production from conventional producing areas reflect a decline beginning in the late 1980s or early 1990s, although others are significantly more optimistic in terms of supply availability.

Natural Gas By-Products

- Deliveries of ethane, propane, butanes and sulphur have been as follows:

	1970	1972	1984	1976	1978
Ethane - MM bbls.	-	-	1.0	1.2	5.2
Propane - MM bbls.	20.1	28.1	32.1	34.9	32.3
Butanes - MM bbls.	12.6	18.5	21.6	24.1	21.3
Sulphur - MM long tons	3.1	3.1	4.9	3.9	5.6

- Production of propane and butane over the forecast period is expected to stabilize or decline slightly depending upon raw gas production and yield. Sulphur production is expected to stabilize at somewhat above the 1979 level, assuming that there is sufficient oil sands production to offset decreasing yields from gas production. Ethane recovery will, of course, show dramatic increases in 1979, 1980 and beyond.

Conventional Oil And Gas Capital Investment And Employment

- Historical and projected capital investment in the conventional oil and gas industry have been and are projected as follows:

	1970	1972	1974	1976	1978
	(Millions of Dollars)				
Historical Capital Investment	411	435	601	1,102	1,774

	1980	1985	1990	1995
	(Millions of 1978 Dollars)			
Future Capital Investment	1,810	1,687	1,517	1,337

- Employment in the conventional oil and gas industry has shown the following pattern.

	1970	1972	1974	1976	1978
	('000)				
Employment	18.2	20.9	23.8	25.8	33.3

2. OIL SANDS

History

- About 700,000 acres of the Athabasca deposit is overlain by 150 feet or less of overburden and considered capable of surface mining. The remaining 16.6 million acres of the four major deposits vary in quality and are buried to depths such that crude bitumen can only be recovered by in situ methods. The current estimate of proven recoverable crude bitumen is 30 billion barrels, which on processing would yield 23 billion barrels of synthetic crude oil. Total reserves of bitumen in place are estimated at one trillion barrels.

- At the end of 1978, over 5.5 million acres of Alberta's Crown lands were under disposition in the oil sands deposits, and a slightly higher acreage was held as undisposed Crown Rights.

- The only commercial development of the oil sands to date has occurred in the Athabasca deposit, near Fort McMurray. The original Great Canadian Oil Sands operation, now part of Suncor Inc., commenced production in 1967 and after many years of operating losses, has rewarded the faith of its owners with gratifying operating results. It currently employs 1,600.

- In late 1978, after an investment of $2.1 billion, the Syncrude Canada Limited consortium commenced production. Authorized production, not yet achieved, is 125,000 barrels per day, utilizing an operating work force of about 4,000. Construction employment peaked at 7,500.

- The next major mining operation, that proposed by the Alsands consortium, but not yet approved, will employ technology generally similar to that of Syncrude and will have an initial design capacity of 140,000 barrels per day. Estimated costs, in 1978 dollars are $3.7 billion, with peak construction staff estimated at 9,100 and operating staff 2,800.

- The first in situ operation, that of Esso Resources Canada Limited was scheduled for 1986 startup, to produce 140,000 barrels per day of synthetic crude. It will use injected steam to reduce bitumen viscosity to the point where it can be pumped to the surface.

- Considerable research into many aspects of oil sands is now proceeding. Much of this is being carried out by private companies. The Alberta Oil Sands Technology and Research Authority has committed in the area of $180 million to research and both senior levels of government are actively involved.

Outlook

- In attempting to assess future oil sands development, three cases were developed - a Reference Case, an accelerated development case and a truncated development case. The Reference Case assumes mining and in situ plants will more or less alternate in development, and that between 1980 and 1995, 1,141 MBD of capacity will come onstream, approximately equivalent to one 210 MBD plant every 2.8 years. This would result in direct 1995 operating employment of 20,800 and gross value of production of $15.3 billion in 1995, measured in 1979 constant dollars.

- The accelerated scenario assumes that roughly one 210 MBD facility comes on stream every 2.3 years between 1980 and 1995. This rate, thought to be more rapid than most experts believe practical, would result in 1995 production of 1,370 MBD, would see direct operating employment of 23,400, and gross value of production of $21.3 billion in 1995, measured in constant 1979 dollars.

- The truncated scenario, designed to show the effect of much smaller oil sands development, contemplates the situation where Suncor and Syncrude reach authorized capacity and the Esso Resources and Alsands projects are completed to initial design capacity, whereupon all additional activity ceases for the decade 1986 to 1995. This results in industry production of 470 MBD in 1995, direct operating employment of 9,800 and gross value of production of $7.3 billion in 1995, measured in 1979 constant dollars.

3. PETROLEUM PRICE ASSUMPTIONS

- For the purpose of examining the sensitivity of the Alberta economy to world energy prices and domestic pricing policy, three price scenarios were developed. The Reference Case is based upon an OPEC price increase averaging two per cent per year in real terms, with an additional five per cent real increase every five years to reflect likely, but completely unpredictable, crises of an economic or political nature in the more unstable producing countries such as Iran.

- These base figures were then adjusted for projected tanker rates; pipeline tariffs; currency exchange rates; Toronto-Chicago oil price relationships; Toronto gas-oil price relationships and the host of other economic and political factors which enter into the existing price formulae for Alberta's oil, gas and basic by-products. In summary, the Reference Case prices are as follows, in constant 1979 dollars.

	1980	1985	1990	1995	Average Annual Growth Rate (%)
Synthetic Crude - $/bbl. (FOB Edmonton)	29.63	32.75	37.10	42.50	2.5
Light and Medium Crude - $/bbl. (FOB Edmonton)	15.02	27.68	33.22	40.19	6.8
Natural Gas (Alberta Border Plus Export Adjustment)	2.59	3.89	4.73	6.34	6.2

- Using the price for Alberta light and medium as the marker, the assumptions incorporated into the high price scenario resulted in an average annual growth rate of 9.1 per cent while those in the lower case averaged 4.1 per cent per year.

4. ALBERTA'S COAL INDUSTRY

- Alberta currently accounts for about 41 per cent of Canada's total coal production.

- Alberta produces three basic types of coal, subbituminous, bituminous (high volatile); and, bituminous (medium and low volatile). These grades currently are sold in various markets, primarily for thermal power generation and steelmaking.

Subbituminous Coal

- A 1974 ERCB estimate placed Alberta subbituminous coal reserves, by 1980, at 50 billion tons, of which 5.6 billion were expected to be surface-mineable and the remainder, underground-mineable. Based on 1978 production of 9.1 million tons, the surface-mineable reserves would last for over 600 years. In addition, it is anticipated that a significant portion of the underground-mineable reserves will be classified as proven, recoverable reserves prior to the end of the century.

- During the period 1970 to 1978, production of subbituminous coal tripled, from 3.9 million tons to 9.1 million tons. Over 94 per cent of 1978 production was consumed within the Province for on-site thermal electric power generation, with most of the balance shipped to Saskatchewan for power generation.

- Subbituminous coal is priced primarily on a utility cost of service basis, with unit price averages in 1977 being $2.64 and $4.49 per short ton respectively for coal consumed inside and outside the Province.

- Although some market diversification into areas such as steam generation for in-situ oil sands plants, petrochemical fuel and feedstocks and other miscellaneous uses is projected, the principal markets for Alberta subbituminous coal will continue to be on-site thermal electric power generation. Demand, estimated at 12 million tons in 1980 is expected to increase to 36.7 million tons in 1995. 1980 unit prices are expected to increase by 25 per cent, in real terms, by the year 1995, reflecting an opportunity value created by such coal in export markets.

Bituminous Coal (High Volatile)

- No significant volumes of high volatile bituminous coal were produced in Alberta prior to 1978, when the Luscar Sterco (1977) Ltd. mine began shipments to Ontario Hydro for use in generation of electric power. Minor additional shipments occurred to West Germany and the United States. Total 1978 production is estimated at 0.85 million tons with production value approximately $3.7 million.

- It is projected that by 1995, export markets and Ontario Hydro will be taking roughly equal amounts of high volatile bituminous coal from Alberta, totalling six million tons annually.

- Since this type of coal is already being marketed at, or near, commodity value, the price is not expected to rise, in real terms, over the period of this study.

Bituminous Coal (Low And Medium Volatile)

- During the past ten years substantial increases in deliveries of low and medium volatile bituminous coal have occurred. The bulk of this coal is destined for the Japanese steel industry (currently accounting for about 87 per cent). That market grew rapidly during the early 1970s but has levelled off recently. In 1978 total Alberta coking coal deliveries were 4.87 million short tons.

- Both surface and underground mining methods are used to recover Alberta's low and medium volatile coal. Prices are determined by the international market place, with 1978 deliveries attracting an average $41.47 per short ton. The value of production of low and medium volatile Alberta coal in 1978 was $201.8 million.

- The demand for Alberta's low and medium volatile bituminous coal is expected to increase from 4.0 million short tons in 1980 to 9.0 million short tons in 1995. Coal prices, in real terms, are not expected to rise over that period.

Total Coal Industry Employment

- In 1980, total direct coal industry employment is expected to be 2,900 increasing to 4,700 by 1995.

NON-PRIMARY SECTORS PROFILES (CHAPTER IV)

A. MANUFACTURING

1. SECTOR OVERVIEW

- Manufacturing is a sizeable but not major part of Alberta's economy. It currently accounts for about 8.5 per cent of the Provincial Gross Domestic Product.

- The manufacturing sector's value of shipments during the 1969-1978 period, grew to 3.7 billion dollars. In real terms, this translates to an estimated 5.2 per cent annual average growth.

- In 1977, the sector employed 68,000 in 1,730 establishments, accounting for 7.8 per cent of the employed Alberta labour force.

- Development of Alberta's manufacturing sector is relatively modest, with its approximate eight per cent of the employed labour force comparing with about 24 per cent and 23 per cent for Ontario and Quebec, and 19 per cent and 17 per cent for California and Texas.

- Alberta manufacturing is regionally oriented with approximately 80 per cent of total output destined for local and regional markets. Approximately seven per cent of goods manufactured in Alberta are destined for export, as compared with 20 per cent from Ontario and 14 per cent from Quebec.

- The manufacturing sector is dominated by the Food and Beverage Industries, which account for approximately 35 per cent of value of shipments and 25 per cent of employment. Using employment as a yardstick, the activity in the balance of the sector is widely dispersed with only one industry, metal fabricating accounting for more than ten per cent of employment.

2. CHEMICAL AND CHEMICAL PRODUCTS INDUSTRIES

- Government encouragement, plus the relative security of feedstock supply and favourable feedstock prices, has resulted in the establishment of several major world scale ethane-based petrochemical facilities in the Province. At full capacity, production from these plants will approximately double the value of Provincial chemical industry output.

- Concern over an industry based on an ultimately depleting natural gas base can be offset to a considerable degree by the long term potential of using oil sands and coal as sources of feedstock.

- The rate at which the industry expands during the fifteen-year forecast period is directly related to the size of capture of export markets. Of the four major industry cost components (feedstock costs, plant capital costs, transportation costs and foreign tariffs), Provincial Government policies can be directed most readily at influencing feedstock costs and to negotiations with respect to tariffs.

- A reduction in the cost of eleven major Alberta produced primary chemicals, equivalent to existing U.S. tariffs might result in a $1 billion (constant 1979 dollars) increase in petrochemical industry capital investment and the addition of approximately 900 incremental direct jobs during the 1980-1995 period. The study Reference Case predicts $3 billion of new capital investment and creation of 3,000 direct new jobs, without the above-mentioned cost reduction.

- It is believed that Provincial Government efforts directed towards reducing tariffs should be continued. Any policy of feedstock subsidies should be pursued with caution and only if cost-benefit analysis shows a positive balance for feedstock subsidy action.

3. FOOD AND BEVERAGE INDUSTRIES

- This industry group dominates the manufacturing sector. In 1977, 367 establishments shipped goods with a value of $2.1 billion, representing 34.1 per cent of sector shipments. Employment of 16,300 in 1977 made up 24 per cent of Alberta's manufacturing employees and 1.9 per cent of the total Alberta employed labour force.

- Real growth of industry value of shipments over the 1969-1978 period, of about 3.5 per cent annually, is not expected to change markedly over the next 10 to 15 years.

- Meat slaughtering and processing and poultry processing account for almost 60 per cent of the value of shipments of the Food and Beverage group with meat processing of much greater significance than poultry processing. (Alberta supplies about 40 per cent of Canadian beef products).

- Over the next 10 to 15 years, growth in the dominant meat processing segment is expected to be tied to availability of slaughtered cattle, grain shipping rates (and hence cost of Alberta feed grain relative to other areas), degree of acceptance of boxed beef in Montreal markets and the level of production and processing of beef products in Quebec and Saskatchewan.

- Although some accelerated growth may occur in output of some segments of the balance of the Food and Beverage group over the next decade and a half, in general, growth is expected to be related to population change.

4. PRINTING, PUBLISHING AND ALLIED INDUSTRIES

- The printing and publishing industry in Alberta is one of a group of "second tier" manufacturing industries - significant in size but much smaller than the food and beverage group. The 1977 value of shipments, from 242 establishments, employing 4,900, was $192 million.

- The industry is heavily oriented to Provincial markets and growth is expected to parallel closely the general economic growth of the Province.

5. WOOD, PAPER AND ALLIED PRODUCTS

- In 1978, Alberta Wood Industries accounted for product shipments with a value of $415 million (5.6 per cent of manufacturing sector shipments). Industry employment (6,100 in 1977) is about 9 per cent of sector employment.

- Coniferous lumber, plywood and pulp are the principal Alberta wood products, with approximately 50 per cent of lumber and 90 per cent of pulp exported to the United States.

- Growth in wood products output is expected to be significant over the next 15 years, with current pulp production projected to approximately triple and lumber output to double.

- Alberta has no paper mills as yet. Therefore, the paper and related products industry in the Province is a modest one.

6. PETROLEUM REFINING

- Petroleum refining is second only to the food and beverage industries in value of shipments by manufacturing industries. Rapid escalation of energy prices have resulted in Alberta's refineries shipping goods in 1978 with an estimated value of $1.4 billion or approximately 18 per cent of total manufacturing shipments. On the other hand, the industry employs less than two per cent of the manufacturing labour force.

- Over the past ten years, Alberta refining capacity has increased from 110,000 to 281,000 barrels per calendar day. Significant further capacity increases are expected over the next 15 years and this, coupled with increases in costs of crude oil feed stocks are expected to cause substantial escalation of the value of petroleum products produced in Alberta.

7. PRIMARY METAL PRODUCTS

- The iron and steel mills, steel pipe and tube mills, iron foundries, smelters, refiners, casting, rolling and extruding mills and a number of related industries, make up this group. In 1977, it accounted for shipments of $292 million from 24 establishments which employed 3,520 or 5.2 per cent of total Alberta manufacturing employees.

- Iron and steel mills and steel pipe and tube mills make up a large part of the group, with most production utilizing scrap iron and steel as the material source.

- Over the past decade, iron and steel industry growth in real terms has been marginal. Future growth patterns are uncertain with substantial new and/or expanded facilities expected in either Alberta or Saskatchewan.

8. METAL FABRICATING INDUSTRIES

- This industry group includes boiler and plate works, fabricated structural metal manufacturers, ornamental and architectural metal manufacturers, metal stamping pressing and coating concerns, wire and wire products manufacturers, machine shops and a number of related miscellaneous industries. In 1977, 224 establishments shipped goods with a value of $339 million (5.6 per cent of manufacturing total) and employed 7,226.

- The industry is not dominated by any single segment. The estimated real, compound annual growth rate in value of shipments over the 1969 to 1978 period was 6.7 per cent. This growth rate while not spectacular, has been relatively consistent from year to year. A similar growth pattern is expected to continue over the next 10 to 15 years.

9. MACHINERY INDUSTRIES

- This group, engaged in the manufacture of argicultural implements, commercial refrigeration and air conditioning equipment and various miscellaneous machinery items, is not a large one, with 1977 shipments of $156 million accounting for only 2.5 per cent of manufacturing sector shipments.

- Over the 1969 to 1978 period, the group showed substantial growth, with shipments recording an estimated compound annual growth rate of 8.6 per cent. Expected future growth in Alberta's resource based industries is projected to result in growth of the machinery industries exceeding that for manufacturing as a whole.

10. TRANSPORTATION EQUIPMENT INDUSTRIES

- This group includes aircraft and aircraft parts manufacturers, motor vehicle and parts manufacturers, truck body and trailer manufacturers, railroad rolling stock producers, boat building and repair industries and miscellaneous vehicle manufacturers. The bulk of production is for Western Canadian markets. In 1977, 65 establishments shipped goods with a value of $166 million.

- Based on preliminary value of shipments data for 1978 and 1979, the group is showing a very cyclical pattern and in the future may not sustain the estimated real growth rate of 5.4 per cent achieved during the 1969-1978 period.

11. ELECTRICAL PRODUCTS INDUSTRIES

- This relatively small group consisted of 27 establishments in 1977, responsible for goods shipments of $25 million. Almost 50 per cent of the value of goods shipped originated with communications equipment manufacturers and major development potential for that industry and another related, high technology industry, microelectronics (currently virtually non-existent in the Province) is believed to exist and is discussed in detail in Chapter VII. The balance of the industry is not expected to experience significant growth over the foreseeable future.

12. NON-METALLIC MINERAL PRODUCTS INDUSTRIES

- Clay product manufacturers, cement producers, concrete products manufacturers, producers of stone products, refractories manufacturers, lime producers and miscellaneous producers make up the non-metallic mineral product industries group. The group consisted of 103 establishments in 1977 with value of shipments $337 million and total employment of 4,662.

- Output of the group, primarily because of product weight and bulk relative to value, ends up in local and regional markets, with 94 per cent of 1974 shipments made to Western Canadian provinces.

- Cement, ready-mix concrete and concrete products account for the bulk of industry output. These industries are all closely tied to construction activity and over the 1969 to 1978 period recorded an estimated real annual compound growth rate in value of total shipments of 6.5 per cent. As in the past, future growth will be dependent on growth in the construction sector.

13. KNITTING MILLS, LEATHER, TEXTILE, CLOTHING, FURNITURE AND FIXTURES, RUBBER AND PLASTIC PRODUCTS, MISCELLANEOUS MANUFACTURING AND TOBACCO PRODUCTS INDUSTRIES

- These diverse industries have been grouped together for summary purposes because of their individual small sizes, relative to the balance of Alberta manufacturing. In 1977, the eight industry groups had goods shipments with a value of $235 million and employed 7,900. This represented 3.9 per cent and 11.8 per cent respectively, of manufacturing sector totals. None of the industries in the group is of major size and few developments are expected over the next fifteen years which would have significant impact on the Alberta economy.

B. CONSTRUCTION

- Activity in this sector is directly dependent on the levels of activity (and therefore, construction demand) in other sectors of the economy.

- Construction's share of Alberta GDP tended to fluctuate over the historical period, rising to a high of 9.6 per cent in 1976 and falling to a low of 7.5 per cent in 1978, which generally reflected the sensivitiy of construction to activity in other sectors.

- During the 1970s, the value of construction work performed almost quadrupled with over half of this growth attributable to residential housing demand and expenditures on oil and gas facilities. At the same time however, labour and material costs more than tripled, evidencing the inflationary pressures created by Alberta's recent rapid growth.

- Employment in this sector accounted for approximately 9.4 per cent of Alberta's total employment in 1978.

- Much of the future growth in construction will likely be generated by the development of large new energy projects and related community infrastructure . combined with Alberta's rising population. From 1980 to 1995, construction real GDP is anticipated to grow at an average rate of 4.3 per cent per year.

- Serious shortages of skilled construction workers may occur at the height of the development period for the large energy projects. Construction employment is expected to account for 9 per cent of total Alberta employment in 1985 but decline to 8.3 per cent by 1995.

C. TRANSPORTATION, COMMUNICATION AND OTHER UTILITIES

1. TRANSPORTATION

- The major transportation modes considered are rail passenger, rail freight, air passenger, air cargo, intercity bus and intercity truck.

- During the 1970s, Alberta's transportation industry experienced significant growth but a declining share of Gross Domestic Product both in real and money terms. Transportation has been characterized by rising prices and factor costs, particularly for fuel and labour, and low rates of return for the rail and air modes.

- With regard to the modal distribution of activity, rail has over the past decade yielded a significant share of freight traffic to long-haul truck while air has remained a relatively minor but growing factor in the freight field.

- Air cargo will continue to experience strong growth in the future. It will capitalize on unused cargo capacity and the economies of wide-body aircraft.

- Major projects such as the Athabasca oil sands and the Alaska Highway Gas Pipeline will create increased, albeit short-lived, demand for the trucking industry. The emphasis in the future will be on greater fuel efficiency and improved environmental and safety standards. Reduced regulatory constraints may also improve the efficiency of the industry.

- Future growth in rail freight will depend on inbound/outbound freight requirements and the ability of the railways to accommodate this traffic within existing capacity. Rail, because of its superior energy efficiency, may recapture some of the traffic it previously lost to long-haul truck.

- It is generally acknowledged that the Crow's Nest Pass Rate on grain must be revised in order to encourage the railways to improve the grain transportation system and to remove other distortions from the freight rate structure. Improvements that are currently being undertaken or proposed to increase capacity, include the introduction of government-owned hopper cars and the development of a new grain terminal facility at Prince Rupert.

- For passenger traffic, the private automobile remains the dominant mode; air travel continues to grow at a significant rate; and rail has assumed a very minor role. Intercity bus has managed to retain its historical share of the market.

- The recent upsurge in air passenger traffic was largely due to the greater availability of discount fares. Discount-induced growth will tend to moderate in the future because of declining passenger yields and rising costs. However, air passenger demand will remain strong in Alberta because of above-average incomes and the trend toward more leisure time.

- Intercity bus will likely experience strong growth in response to rising gasoline prices for the private automobile and escalating air fares.

- With major improvements to increase speed and frequency of service, rail may be able to compete effectively for passenger traffic in short-haul markets. In long-haul markets rail cannot compete with the speed and convenience of air travel.

- Overall, the Alberta transportation industry will experience continued strong growth over the next decade but may not keep pace with the rest of the Alberta economy.

2. COMMUNICATION

- The industry includes telephone systems, radio and television broadcasting, post office, telegraph and cable systems.

- The communication industry represents a small part of the Provincial economy, accounting for less than six per cent of Alberta gross investment during the 1970s and only 2.1 per cent of total employment.

- The telephone system, operated by AGT and Edmonton Telephones, is the largest industry component in terms of both investment and employment. By the end of 1978, the two utilities owned over one million telephones.

- The telephone industry is projected to capture a larger share of the communication market due to technological revolutions that are anticipated to occur in the telecommunications industry. In particular, the telephone system will likely replace many existing telegraph and postal services with the development of lower-cost digital-oriented networks designed to transmit integrated data, image and voice communcations.

- Radio and television developed extensive coverage in Alberta during the 1970s with cable television experiencing the most pronounced growth in broadcasting. About 70 per cent of the households in Calgary and Edmonton had cable in 1979.

- Since radio and television broadcasting presently reaches almost every household in the Province, future growth in this industry will largely depend on population growth and the development of new broadcasting services. Cable television may be expected to further increase its market penetration, especially in the non-metropolitan areas.

- Available data indicate that postal and telegraph services have tended to decline in relative importance over the historical period and this trend is expected to continue in the future. The postal service may be particularly vulnerable to losing its market share because of rapidly escalating mail processing and distribution costs.

3. UTILITIES

- During the 1970s, utilities accounted for less than three per cent of Alberta GDP but over seven per cent of Alberta gross investment.

- The dynamic growth of the Provincial economy and its population will likely stimulate significant growth in utilities, although certain structural changes will occur due to changing energy prices and conservation measures.

- Historically, the electric utilities experienced a strong growth in demand, which is expected to continue in the future, where electric energy's share of Alberta's total energy needs is projected to increase from nine per cent in 1977 to 15 per cent in 1995.

- Substantial gross investment in electric utility facilities, totalling some $15 billion over the years 1979 to 1995 inclusive, will be required to meet the demand for electric energy. This growth will likely cause electric utility rates to double over the forecast period.

- The gas utilities also experienced strong growth in demand during the 1970s; however, future growth will be slowed due to rising gas prices relative to other energy forms and conservation efforts. As a result, natural gas will decline in importance from 40 per cent of Alberta's total energy resource needs in 1977 to 26 per cent by 1995.

- Gas utilities investment will be modest, totalling less than $1 billion for the years 1979 to 1995 inclusive. Nevertheless, utility rates may increase ten-fold due to rapidly escalating domestic gas prices.

4. PIPELINE TRANSPORT AND STORAGE

- During the height of new construction activity in the early 1970s, oil and gas pipelines accounted for approximately 50 per cent of the total value of construction in the transportation industry. Future growth in this sector will depend on government policy decisions made in both Canada and the U.S.

- In Alberta, grain elevators represent the main component of storage. This industry represented only one per cent of total sector new construction in 1977.

5. TOTAL TRANSPORTATION, COMMUNICATION AND OTHER UTILITIES SECTOR

- During the 1970s, the total sector accounted for approximately 10 per cent of Alberta GDP but averaged 19 per cent of Alberta gross investment. This reflects the highly capital intensive nature of most industries in the sector, especially the utilities.

- Owing to the diversity of industries in the sector, future growth will directly depend on a number of factors. These include not only rates of general economic development, population growth, technical change, and increases in relative energy prices, but also government policy decisions regarding the timing and magnitude of major energy projects, public expenditures on transportation-related infrastructure and the distribution of development throughout the Province. Significant structural changes are anticipated to occur within the individual industries over the forecast period.

D. FINANCE

- During the 1970s, the finance sector accounted for an average ten per cent of Alberta GDP, with part of its growth attributable to the recent influx of Canadian and foreign financial institutions into the Province. A principal reason for this influx is the perceived growing demand for capital funds, particularly by the energy industries sector, for the development of planned energy projects.

- Wages and salaries in finance quadrupled while employment doubled during the historical period, causing average wages to double. Employment in this sector accounted for only 5.6 per cent of the total employment in Alberta in 1978.

- Over the 1980 to 1995 period, finance real GDP and investment are expected to grow at an average annual rate of 4.2 per cent and 0.5 per cent, respectively.

- Finance employment is forecast to grow at a relatively high rate of 4.9 per cent per year, reflecting the labour-intensive nature of this sector and a movement towards more service-oriented activities in the Province. This sector is seen to account for eight per cent of total Alberta employment by 1995.

E. SERVICES

1. TOURISM

- The tourism system in Alberta is made up of four major components: the resident and non-resident tourists in the Province; the businesses providing tourist goods and services; the governments of the host region; and, the host community. (Tourism includes business and convention travel.)

- The tourism industry in Alberta generated revenues of about $900 million in 1978, or about 3.5 per cent of Provincial GDP.

- There are a number of major constraints/problems which are seriously hindering the development of tourism in Alberta, including:

    - tourism is currently highly concentrated in Banff, Jasper, Calgary and Edmonton. The capacity of the National Parks is simply inadequate. Because of the lack of sufficient facilities, those in existence tend to be crowded during certain periods;

    - apathy or resentment towards tourism on the part of the general population;

- the attractiveness of investment opportunities in other segments of the economy, and the pressure to develop other more sophisticated industries, have diverted attention from tourism in the establishment of government investment and development programs;
- difficulties in recruiting, developing and retaining qualified staff in the tourism industry.

2. ALL SERVICES

- The services sector is characterized by a wide diversity of industries in terms of the types of services provided, producers and the consumers.
- During the 1970s, the sector's share of Alberta GDP and investment tended to decline.
- Growth in services wages and employment was modest; nevertheless, this sector accounted for 27 per cent of Alberta employment in 1978 making it an extremely important sector with regard to labour policy considerations.

Over the period 1980 to 1995, services real GDP, net investment and employment are respectively projected to grow at average annual rates of 3.9, (0.8) and 2.6 per cent. Services is expected to remain as one of Alberta's major employment sectors throughout the forecast period.

F. TRADE

- Historically, trade's share of Alberta GDP and gross investment declined to 9.6 per cent and 2.0 per cent respectively, by 1978.
- The number of employees in trade accounted for about 19.2 per cent of Alberta's total employment in 1978, thus making it one of the more important sectors in terms of labour policy considerations.

- Future growth in the trade sector will be mainly generated by rising levels of personal disposable income and population growth in Alberta. Over the 1980 to 1995 period, trade sector real GDP is forecast to grow at the same rate as Provincial GDP while no real growth in trade net investment is anticipated.

- Conversely, trade sector employment is expected to grow at a significantly higher rate of 4.2 per cent per year relative to the growth rate of 2.7 per cent per year for total Provincial employment.

G. PUBLIC ADMINISTRATION

- The public administration sector covers a narrow range of government establishments primarily engaged in general administrative and defense activities. The remaining government-owned or operated establishments are assigned to other industrial classifications according to their principal activity. Thus, the public administration sector itself forms a relatively small part of the Provincial economy and does not reflect the full magnitude of government interactions.

- During the 1970s, the sector's share of Alberta GDP declined to less than six per cent while its share of Alberta gross investment averaged about 11 per cent. Employment in this sector accounted for less than seven per cent of Alberta's total employment in 1978.

- A clearer indication of the actual extent of government involvement in the economy may be provided by the more broadly defined general government sector which includes publicly-owned schools and hospitals. General government current and capital expenditures comprised over 17 per cent of Alberta GDP in 1978. Moreever, in 1977, approximately 11 per cent of Alberta's workers were employed in general government services.

- Future growth in the public administration sector will not only be influenced by population growth and the rate of economic expansion, but also by discretionary government policy.

- Over the 1980 to 1995 period, sector real GDP and net investment are projected to grow at an average annual rate of 3.2 per cent and (0.7) per cent, respectively. As with the other service-oriented industries, employment is forecast to grow at a relatively high average rate of 3.9 per cent per year and is anticipated to account for nine per cent of Alberta employment by 1995.

AN OVERVIEW OF THE OUTLOOK FOR THE PROVINCIAL ECONOMY (CHAPTER V)

This Chapter reviews the results of a computerized econometric simulation of the Provincial economy, operated under a number of scenarios and with a number of sensitivity tests. The model was developed to enhance the assessment of the direct and indirect effect on the total Provincial economy of (i) major new industrial projects or the addition of new industries; (ii) changes in the rate of expansion or contraction of existing sectors or industries; (iii) the impact of various development strategies; and, (iv) the general effects on Alberta of changes in the performance of the overall Canadian economy.

A. GENERAL DESCRIPTION OF THE ECONOMETRIC MODEL

- In the model, the Alberta economy is conceptualized as the interaction of ten distinct, but mutally dependent industry structures and a demographic sector. Each industry is viewed as both a supplier of output and as a user of inputs. The model assumes a number of direct linkages with the larger Canadian economy. Many of the key internal variables in the model were developed in constant dollars, with 1971 chosen as the base year. All major variables relating to the key energy industries sector are exogenous inputs.

- An input-output table is incorporated into the model and statistical estimates, developed outside the model, are superimposed on it.

B. SCENARIO AND SENSITIVITY CASE DESCRIPTIONS

- A Reference Case and three alternative Alberta economic scenarios were developed to match each of the alternative world economic scenarios postulated by SRI International in

Volume II of this report. The Reference Case assumed moderate world economic growth and real oil price increases of two per cent annually, with an additional five per cent jump every five years. Alternative #1 was predicated on a significantly weaker world economic environment and Alternative #2 was developed assuming OPEC oil prices would escalate 3.5 per cent annually in real terms, with resultant weaker world economic performance. Alternative #3 was designed to measure the impact of lower real oil prices over the 15-year term.

- Ten sensitivity cases were developed to assess the impact on the Alberta economy of various alternative development paths in key sectors and industries, differing energy price forecasts and changes in the future performance of the Canadian economy. (The reader is referred to Chapter V of Volume III for the results of this analysis.)

C. A GENERAL SUMMARY OF THE RESULTS

- The Reference Case produced an average annual real Gross Domestic Product growth rate of 4.0 per cent for the 1980 to 1995 forecast period. This compares with a 6.8 per cent GDP real growth rate during the 1965 to 1980 period. This projected Alberta GDP growth rate relates to forecasts for other jurisdictions as follows:

Geographic Area	Average Annual Real GNP Or GDP Growth Rate, 1980-1995
	(Per Cent)
World	3.8
United States	3.0
Canada	3.5
Alberta	4.0

- The alternative scenarios reflected the impact on Alberta's economy, of changes in world economic outlook. Alternative #1, which reduced the real Canadian GNP growth rate from 3.5

per cent in the Reference Case to 3.0 per cent, translated into an Alberta GDP real growth rate of 3.7 instead of 4.0 per cent. Alternatives #2 and #3 illustrated the significant impact of energy price changes. In Alternative #2, the scenario design was intended to show how higher energy prices cause overall weaker world economic performance. However, for Alberta, the higher energy prices resulted in the Provincial GDP real growth rate being 4.8 per cent instead of the Reference Case 4.0 per cent.

D. AN ANALYSIS AND DISCUSSION OF KEY ELEMENTS

1. CHANGES IN NEW INVESTMENT

- The level of new capital investment, in the Alberta resource sector driven economy, is a key element in influencing growth rate. During the historical period 1962 to 1974 new real capital investment fluctuated around the level of $1.0 billion annually. Commencing in 1975, with the Syncrude plant construction, new real investment doubled and has remained at that level. The econometric model projects a further major increase about 1985 to the approximate $3.0 billion level annually. (See Figure V-1, Volume III)

- Oil sands investment represents the major component of new capital investment in the forecast period. Figure V-2 illustrates a breakdown of new capital investments into four major categories, oil sands, conventional oil and gas industry expenditures, other major specifically defined industrial projects and the total investment in all other sectors of the economy.

TOTAL NEW CAPITAL INVESTMENT

	Historical Period 1962-1977		Forecast Period 1978-1995	
	Investment	Per Cent Of Total	Investment	Per Cent Of Total
	(MM 1971 $)	(%)	(MM 1971 $)	(%)
Oil Sands Development	1,400	8	18,100	37
Conventional Oil, Gas & Coal Mining Industries	4,100	24	7,400	15
Major Industrial Projects Defined In The Industry Forecasts	-	-	2,100	4
Investment In Other Sectors Of The Economy	11,500	68	21,900	44
Total	17,000		49,500	

- Shifts in the level of new investment significantly affect the rate of economic growth as demonstrated in Figure V-3.

2. THE STRUCTURE OF THE PROVINCIAL ECONOMY AND THE IMPORTANCE OF THE ENERGY INDUSTRIES SECTOR

- The model calculated the percentage contribution to total Provincial GDP of the ten econometric sectors (as follows, in constant 1971 dollars):

PERCENTAGE CONTRIBUTION TO GROSS DOMESTIC PRODUCT BY MAJOR ECONOMIC SECTOR*

Economic Sector	1965	1970	1975	1980	1985	1990	1995
				(Per Cent)			
Agriculture	8.8	6.7	5.4	4.2	3.4	3.1	2.7
Forestry	0.3	0.2	0.1	0.1	0.2	0.2	0.2
Energy Industries (inc. provincial royalties)	11.9	16.2	18.4	20.8	20.4	19.3	20.1
Manufacturing	9.3	8.9	9.0	8.7	9.2	10.1	10.4
Construction	7.7	8.7	8.9	9.3	9.9	10.0	9.8
Transportation, Communication & Other Utilities	11.4	12.1	12.0	12.6	12.8	13.0	12.9
Trade	11.3	11.1	11.7	11.0	11.2	11.3	11.1
Finance	13.5	10.7	9.5	10.8	10.9	11.2	11.2
Services	16.4	18.2	17.1	16.6	16.2	16.4	16.3
Public Administration	9.3	7.9	7.8	6.0	5.7	5.4	5.3
Total**	100.0	100.0	100.0	100.0	100.0	100.0	100.0

* Based on Constant 1971 dollars.

** Totals may not add due to rounding.

- The preceding presentation utilized constant 1971 dollars as the basis for calculations. This masks the real economic wealth generated by the energy industries sector because major price increases are not reflected. In order to illustrate what may be a more representative picture of the contribution of the energy industries sector to the Provincial economy, an analysis using nominal or current year's dollars was carried out, using an inflation factor of seven per cent in addition to real energy price increases. Results are as follows:

ENERGY INDUSTRIES SECTOR CONTRIBUTION TO TOTAL ALBERTA GDP
(Reference Case Projections)

	Alberta GDP	Energy Industries Sector GDP	Energy Industries Sector GDP As A Per Cent of Alberta
	(MM Current $)		(%)
1978	24,886	6,699	26.9
1980	33,114	9,537	28.8
1985	65,529	21,687	33.1
1990	111,928	37,319	33.3
1995	186,284	67,488	36.2

3. THE IMPACT OF FUTURE ENERGY PRICES

- A preliminary review of data indicates that a one per cent change in crude oil prices may induce an approximate 0.4 per cent change in total Provincial GDP.

4. DEMOGRAPHIC AND LABOUR FORCE VARIABLES

- The econometric model generates several basic demographic and labour force variables including Provincial population, employed labor force, the Provincial unemployment rate and the level of annual net migration to the Province.

- The Reference Case projection indicates a population increase from 2,070,000 in 1980 to 3,073,000 in 1995. This represents an average annual growth rate of 2.7 per cent compared to the 1965 to 1977 historical growth rate of 2.3 per cent.

- Reference Case projections of employed labor force indicate an absolute increase of 417,000 in 1995 over 1980, representing an annual average growth rate of 2.7 per cent.

- The breakdown of employment by sector has been projected as follows:

ALBERTA EMPLOYMENT
- A PERCENTAGE BREAKDOWN BY SECTOR

Economic Sector	1970	1975	1980	1985	1990	1995
	(Per Cent)					
Conventional Energy Industries Sector	3.3	4.4	4.4	3.7	3.4	3.1
Oil Sands Development	0.1	0.2	0.5	0.7	0.6	1.5
Total "Mining" Sector	3.4	4.6	4.5	4.4	4.0	4.6
Trade	16.6	18.7	19.5	21.4	23.1	24.2
Public Administration	6.1	7.0	7.6	8.1	8.6	9.0
Agriculture	18.6	14.6	8.8	6.5	5.1	4.0
Services	26.3	26.6	27.6	27.4	27.2	27.3
Transportation, Communication & Other Utilities	8.2	8.5	7.4	6.2	5.0	4.0
Construction	7.9	7.4	8.9	9.0	8.6	8.3
Manufacturing	8.9	9.1	9.1	10.0	10.1	10.1
Forestry	0.3	0.3	0.3	0.3	0.3	0.3
Finance	3.9	4.4	5.9	6.8	7.4	8.1
Total*	100.0	100.0	100.0	100.0	100.0	100.0

* Totals may not add due to rounding.

- Using the Reference Case, projected levels of net migration to Alberta are as follows:

Year	Net Migration (Thousands)
1979	35.8
1980	23.4
1981	18.8
1982	24.9
1983	44.7
1984	53.1
1985	46.1
1986	40.9
1987	41.8
1988	42.8
1989	36.4
1990	32.4
1991	32.7
1992	32.8
1993	29.4
1994	26.5
1995	23.3

STRENGTHS AND WEAKNESSES - GOAL ACHIEVEMENT - OPPORTUNITIES AND THREATS (CHAPTER VI)

This Chapter, in a qualitative way, provides the project team's general assessment of Provincial strengths and weaknesses, Provincial Government objectives for Alberta, the sensitivity of major industries to government stimulation and initiatives, and prospective opportunities and threats facing Alberta over the next 15 years.

A. STATEMENT OF STRENGTHS AND WEAKNESSES

1. APPARENT STRENGTHS IN THE ALBERTA ECONOMY AS A FOUNDATION FOR FUTURE DEVELOPMENT

Governmental

- a stable government, supportive of competitive enterprise and oriented toward growth and development of acceptable proportions;

- a willingness to work for the future well-being of Alberta's citizens within a federal state;

- an industrial regulatory process which is generally regarded as being adequate to both development and the requirements of society;

- resource revenues which may be regarded as being substantially surplus to reasonable requirements for normal government services, although such revenues, even if temporary, tend to increase demands and expectations for services above "normal" levels (i.e., a prospective weakness);

- a number of relatively smoothly functioning government departments and agencies, whose purpose is generally understood and whose personnel are well experienced, although handicapped in some instances by high rates of turnover of staff;

- corporate taxation policies and the ability to provide incentives which can make Alberta an attractive location for new or expanding industries;

- a well developed municipal government system, generally capable of absorbing increased population and industrial projects, provided that adequate financial assistance is at hand.

Societal

- a young, generally vigorous population, oriented toward a high quality of life;

- large and reasonably well regarded universities and technical schools, together with regionally dispersed colleges of growing quality;

- two equally large concentrations of population, each providing unique cultural and recreational opportunities at a growing rate, the further development of which would be supportive to the attraction of high technology talent; several strong regional centres are also emerging and becoming capable of supplying an attractive living environment;

- attractive, reasonably accessible, and fairly well developed outdoor recreational facilities, together with a moderate climate and a relatively pest-free environment in the more populated areas of the Province;

- an attractive personal income, sales and succession tax structure plus relatively low cost, high quality health care and education systems.

Commercial

- abundant fossil fuel resources plus the existence of a substantial exploration, development, production and service industry;
- a buoyant and dynamic economy, with entrepreneurial instincts strongly developed in certain sectors;
- a well trained labour force operating at comparatively high employment levels;
- a large, viable service and financial sector with significant and growing direct access to international capital markets;
- a strong agricultural base with considerable low cost expansion potential, within the presently developed land system, given resolution of certain fundamental extra-provincial problems;
- a very large fresh-water resource base which, at present, is adversely located - a situation, however, which could be corrected at a cost which might be outweighed by the benefits;
- under-utilized forest products potential, in a generally well established, although fragmented, industry;
- a secure supply of comparatively low cost energy.

- an emergent but small, research and development capability of quality and substance, which ultimately could generate near and long term commercial potential;
- comparatively low, and prospectively lower, corporate rates of taxation;
- a strong construction/design/engineering industry, capable of undertaking major projects.

National/International

- relative proximity, when compared with other continents, to the free world's largest industralized market;
- no direct burden for the provision of national defence, currency stabilization and other Federal responsibilities which could place Alberta at some advantage when vying with other countries for new industrial enterprises;
- the perception, by certain other countries, of Canadians being capable of providing a comfortable bridge between their own cultures and the American business community;
- some recognition, by others, of Alberta as a dynamic rich, resourceful and stable region, albeit within a nation which is well regarded but with a questionable economic (and political) future;
- ready access to American-developed technology due to proximity, language, similarity in currency, logistical systems and joint ownership of industrial enterprises (which can also be regarded as a weakness to the extent that it tends to stifle our own creativity).

2. APPARENT WEAKNESSES IN THE ALBERTA ECONOMY WHICH MAY STIFLE ECONOMIC DEVELOPMENT

Geographical

- a small population with a correspondingly small local market, resulting in relatively few economies of scale for locally produced manufactured goods and services;

- large distances from major existing markets and areas of concentrated population which might represent prospective new markets;

- lack of access to deep-water transportation systems, combined with excessive reliance upon extra provincial labour - management relations within the transportation sector;

- limited fresh-water availability in extensive, semi-arid portions of the Province;

- under developed south-bound transportation links, particularly road and rail, which tend to offset advantages that might be perceived to accrue by virtue of Alberta's proximity to the U.S.;

- a concentration of tourist attractions in the relatively small Foothills region, which is also a major source of developable natural resources.

Societal

- limited cultural and recreational opportunities in some areas of the Province which can cause further population concentrations in the major centres;

- a comparatively high cost of living, particularly in terms of housing, and certain manufactured goods and food products;

- some disparities in incomes and employment opportunities between regions within the Province;

Commercial

- significant dependence on non-renewable resources as a source of government revenues, personal incomes and employment;

- pending revenue loss from depleting conventional light and medium oil reserves;

- the majority of Alberta's existing fossil fuel resource is presently beyond economic reach with existing technology, notably oil sands and conventionally produced crude oil (the latter due to relatively low recovery factors);

- relatively few major opportunities for growth from the existing manufacturing base;

- certain existing activities such as the production of grain, livestock and metallurgical coal, for example, are extremely dependent upon the vagaries of a few export markets;

- shortage of farm labour, which could become even worse with a buoyant economy; shortage of a growing number of other applied skills necessary to major industrial growth and diversification;

- labour and many other costs of production which are high relative to those of the less developed countries;

- an absence of commercially viable metallic mineral resources in the Province;

- a relatively narrow technological base and a dependence upon imported, rather than indigenous technology - probably a manifestation of the Canadian "branch-plant" syndrome.

National

- constitutional and other constraints to development which face any region attempting to grow within a national framework;

- vulnerability to Federal intervention and to central Canada oriented Federal policies which tend to inhibit the Alberta investment climate;

- weakness of the transportation network, together with high and frequently discriminatory freight rates which are substantially beyond the control of the Province;

- reliance upon federally controlled marketing boards and agencies for the sale (and pricing) of commodities critical to the Province;

- vulnerability to fluctuating exchange rates, balance of payments problems, tariff agreements and other aspects of our economic well-being over which we have little or no control;

- a perception, in some parts of Canada, that Alberta is not appropriately investing its revenues.

B. OBJECTIVES AND INITIATIVES

- The Provincial Government's apparent objectives for Alberta's future consist of the following:

Diversification - the desire to reduce the Province's dependence on depleting non-renewable resources.

Balanced Growth - the goal of spreading future economic growth throughout the Province.

Strengthen Small Business - the provision of the environment in which small, locally-controlled businesses would be able to thrive.

Upgrade Citizen Skills - the goal of upgrading the skills and the employment opportunities of Alberta's citizens.

Upgrading Natural Resources - the objective of decreasing the number of jobs which are exported along with Alberta's renewable and non-renewable unprocessed natural resources.

Tourist Potential - optimizing the use of Alberta's tourist attractions.

Encouraging Research - the policy to encourage basic and applied research in the Province.

Growth Potential - the objective of economic growth of manageable proportions.

Economic Stability - the desirability of causing growth and diversification to occur in a stable manner.

Quality of Life - causing changes to occur in a fashion which preserves and improves the physical environment and present life style, while at the same time provides economic, social and cultural amenities to attract the kinds of people needed for the future.

Bargaining Position - the objective of preserving and strengthening Alberta's ability to compete effectively in the bargaining process, both within and outside Canadian boundaries.

- The fact that many of these goals and policy areas are interrelated must be considered when developing an economic strategy.

- The project team took those major, existing Alberta industries considered most susceptible to direct government initiatives and ranked them against the above outlined objectives in order to determine which industries could be stimulated to best meet the overall Government objectives. While the analysis was a very subjective one, the broad general conclusions appear valid. Those existing industries which best appear to merit additional government initiatives are:

  - oil sands and heavy oil, agriculture, coal, petrochemicals and some elements of manufacturing

  (The reader is referred to Tables VI-1 and VI-2 of Volume III for the detailed results of this analysis.)

C. OPPORTUNITIES AND THREATS

1. APPARENT OPPORTUNITIES

- The opportunity to maximize development of oil sands and heavy oil consistent with the Province's ability to manage that activity.

- If major increases in Alberta natural gas reserves are correctly projected, Alberta will be in a position to develop a growing petrochemical industry, to benefit from exports and at the same time make a substantial contribution to the Canadian economy.

- Alberta has the economic muscle to create an environment attractive to technology-intensive industries, in demand throughout the world.

- Should the world demand for grain become stronger as predicted by many experts, Alberta is in a position to increase production very significantly through a number of relatively low cost alternatives.

- Alberta has large stockpiles of elemental sulphur which may be marketable in increasing quantities and at more favouralbe prices.

- Alberta coal reserves are a major under-utilized resource with good market prospects in raw form and considerable potential through technological advances in liquefaction, combustion or gasification.

- Only a minor portion of Alberta's irrigated land is utilized for crops which demand irrigation. Initiatives resulting in greater production of vegetables, in turn, would result in expanded agricultural processing.

- Deteriorating relationships between the U.S. and the Soviet Union are resulting in increased U.S. defence activities. A technology-intensive environment in Alberta might benefit from such things as plants to produce military electronics.

- There obviously exists an opportunity to resolve Southern Alberta's approaching water shortage by more efficient use of existing supplies in the South and by eventual diversion of Northern Alberta supplies to the South. The costs and benefits of such efforts require careful examination.

2. APPARENT THREATS

- The emergence of Mexico as a full-fledged member of the North American community reduces the chances of bilateral Canadian-U.S. agreements which could be of significant benefit to Alberta. Mexico also is likely to become a formidable competitor to Alberta's petrochemical industry.

- Alberta's economic future will continue to be dependent upon energy, with resultant uncertainties, many of which are not within the Province's control.

- It appears unlikely that the natural evolution of Alberta's existing non-energy industries will be sufficient, over the short to medium term, to counter-balance the Province's dependence on energy.

- Should global economic conditions, led by the effects of increasing energy costs, result in greater protectionism and reduction of world trade, adverse impact on Alberta's markets for metallurgical coal, fertilizers and petrochemicals, could result.

- Pressures for even more widespread distribution, amongst Canadians, of energy related revenue may emerge, as a consequence of federal policies.

- A present weakness and a potentially major threat to Alberta's economic development will be the difficulty of obtaining people skills when and where needed.

- Modest economic growth prospects and other factors are expected to lead to more intense export competition amongst nations. Consequently, international economic relations are likely to become more politicized. For a sub-national entity like Alberta, whose economic welfare is greatly influenced by external forces, this implies even less than present control over economic destiny.

- Alberta's grain trade is continuously at risk, normally in a cyclical fashion, from adverse weather, possible world recessions, bumper crops elsewhere, political instability in parts of the Pacific Rim and by potential Soviet hard currency shortages.

DIVERSIFICATION AND EXPANSION OF THE ALBERTA ECONOMY (CHAPTER VII)

A. TECHNOLOGY AND ALBERTA'S FUTURE

- It has been broadly recognized that one of Alberta's weaknesses is its dependence on the sale of depleting natural resources. This study confirms that the Province's future is critically linked to the energy sector and that the objective of diversifying the Alberta economy remains as valid as ever.

- A limiting factor on the Province's ability to diversify is the fact that it is a region, with real restrictions on its ability to control its own destiny.

- Existing manufacturing operations, which are regionally rather than export oriented, are expected to grow primarily in response to population increases and expansion of resource development activities. A significant short or medium term shift of the preponderance of economic strength from the energy industries sector to existing manufacturing or other sectors is not expected.

1. KNOWLEDGE AND TECHNOLOGY INTENSIVE INDUSTRY

- To achieve a real and significant diversification of the economy, the most promising strategy appears to be one aimed at stimulating the formation and development of new, export-oriented industries.

- The new, export-oriented industries most appropriate for Alberta appear to be the knowledge and technology-intensive ones at the leading edge of industrial development.

World Perspective

- There is no inevitable correlation between successful research and development and commercial exploitation. From the end of World War II until the late 1960s, the United States was the undisputed world leader in both research and commercialization. However, the current leaders in the exploitation of advanced technology are Japan and some European and other Asian countries.

- One reason advanced for the current Japanese and European success in the innovative and commercial development process, is national focus on industrial policy, which integrates business, government and quasi-government planning and recognizes that total reliance on free market forces is not adequate to optimize economic growth.

- Another reason for successful exploitation of new technology is the purchase of such technology and its implementation with the use of low cost labor, in countries such as South Korea, Taiwan, Ireland and Spain.

- A current preoccupation in the U.S. with short term economic gains has affected its position of technological eminence, as has concentrated research activity aimed at environmental protection.

- Since 1969, total U.S. research and development expenditures (in real terms) have remained essentially constant as have research and development employment levels. In contrast, Japanese research and development employment of scientists and engineers, during the same period, has doubled on a per capita basis.

The Canadian Perspective

- Canada's efforts in commercialization of new technology are very modest and related to our generally recognized position as a branch plant economy of the U.S. Recent figures indicate that Canada's research and development expenditures, relative to gross national product, (an accepted measure of degree of pursuit of the advantages in knowledge and technology industries) are only one third to one half those of the more progressive innovator nations.

- Many experts believe that in the past, the wealth of a nation depended on natural resources, while in the future, success will depend on technological progress and use of resources. If this is correct, Canada is not following the road to future success.

- Suggested reasons for Canada's poor performance as an innovator include a tariff policy that has protected Canadian industry but encouraged inefficiency; and foreign ownership of Canadian industry, with resultant truncation of industrial structures and in particular, limitation of research and development.

- The development of a national industrial strategy is considered by many as the key to resolving many of Canada's industrial problems. Development and implementation of a strategy is likely to be difficult, if not impossible.

The Role of Knowledge and Technology-Intensive Industry In Goal Achievement

- As part of its evaluation, the study team identified a number of principal goals for the Province. As the next step, the group assessed the expected ability of government stimulative initiatives (when applied to a number of industries) to achieve these goals. Included in the "industries" evaluated, were education, research and development and microelectronics, telecommunications and pharamceuticals (three technology-intensive industries considered to have potential for development in Alberta). All five of these "industries" scored well as to ability to be stimulated for goal achievement.

2. THE HIGH TECHNOLOGY SYSTEM

- The evaluation of technology-intensive industries involves identification of needs, research and development activity, technical innovation and commercialization.

- The study concludes that the Government of Alberta can, by the application of appropriate stimuli, help to overcome many of the impediments to the natural growth of knowledge and technology intensive industries. It is also the conclusion that the most appropriate Governmental role is to create a high technology environment, to provide needed stimuli and to fill the gaps in the system so that the private sector can create, develop and expand a range of new economic activities.

Identification of Needs

- This process has progressed well in Alberta, but must be continued.

Education As An Input To Research And Development

- Education at the post-graduate level is critical to vigorous research and development activity. It is believed that attraction of superior faculty, in needed disciplines, is a necessity.

- Excellence at the senior university level will be achieved by concentration of new post graduate activities. Such concentration may be offset by having under-graduate and technical education more dispersed throughout the Province.

- Should the current education systems fail to meet future challenges, the Government should be prepared to make necessary adjustments.

- The need to provide for more extensive training in the skilled trades is emphasized.

Research And Development

- Preliminary examination of the levels of government sponsored or assisted research indicate serious intentions and the expectations of effective and useful results.

- A prospective problem, in the event of major development of industrial research activity, is the need to assure longer term stability of Government funding in order that the needed number of researchers may be attracted and retained.

- If need identification dictates, the mechanism of the Alberta Heritage Foundation for Medical Research could be repeated in other areas of high technology research.

- The Alberta Research Council's five-year plan places emphasis on drawing the private and public sectors closer together. There also is a perceived need to assure that research and development activities are physically carried out as close as possible to the commercial ventures they are trying to serve.

The Innovation/Commercialization Process

- The presence in Alberta of active advanced education programs and a strong research and development community are not in themselves likely to result in major new areas of economic activity. U.S. experience has shown that other factors impinging on strong educational/research and development systems have, in recent years, caused the development elsewhere of much of the commercial exploitation of U.S. research.

- It appears essential that the Provincial Government, in any program to stimulate the innovation/commercial process, should commence with a thorough examination of the innovation process. Historically, efforts to develop innovation simply through generous government research support, have often failed to evolve into commercial production.

- To attract to, and retain, capable entrepreneurs in Alberta, the proper environment is essential. Requisites include access to new ideas; technological support; tax incentives; an adequate labour force; a free enterprise oriented political atmosphere; and access to risk capital.

3. VENTURE CAPITAL

- Venture capital may be defined as early stage equity investment in non-publicly traded companies. It normally is required for a number of phases of the development of a new operation:

  (a) pre start-up
  (b) start-up
  (c) development
  (d) expansion

- Many will argue that venture capital is at the heart of the free enterprise system, being critical to the implementation of new ideas and the creation of economic growth. Traditionally, in the U.S., a world leader, innovation has come in large part from small firms.

- Relatively speaking, the venture capital industry is very strong in the U.S. with over 500 firms providing funds for young, growing ventures. By comparison, there are about 50 venture capital companies in Canada, 30 in Western Europe and about a dozen in Japan.

- In both the United States and Canada, venture capital activity declined sharply in the early and mid-1970s, from the high levels of the 1960s. However, there are indications that this situation may have turned around in 1979 in the United States.

- The Canadian venture capital industry is not nearly as strong as that in the U.S. Most Canadian concerns are too small to be consistent suppliers of venture capital and few can handle situations requiring more than one million dollars. At present there are perhaps only 15 reasonably active Canadian venture capital companies, each of which may finance three ventures per year.

- There are many factors which are evident in most successful venture capital companies, including good external visibility in the business community; good management; a widely diversified mix of investments (both as to type of operation and stage of risk); a relatively small group of decision makers; a monitoring system for investments, usually through board of director representation; frequent use of venture capital partners; willingness to assist client entrepreneurs through providing managerial, financial and technical expertise; sufficient commitment to ventures to wait a reasonable period for goal achievement; competent, experienced staff; commitment of substantial funds to individual ventures (minimum of $250,000 to $1,000,000); a screening program which examines many more proposals than are accepted (a reasonable target is investment in one per cent of proposals considered) and capability of performing or contracting specialty analysis such as technical evaluation and market research.

Why Should Alberta Consider Venture Capital To Be A Potentially Important Element In The Province's Economic Strategy?

Venture capital would serve the following purposes in Alberta:

(a) It is one major instrument which can be used to attract and stimulate the process of innovation within the Province and to transform, into successful commercial applications, research discoveries which can be expected to flow from R & D expenditures.

(b) It can be used to attract to Alberta, entrepreneurs from the world-wide scientific and technical community, thus helping the Province to exploit the fall-out from research and development done both within Alberta and elsewhere.

(c) There is presently intensive competition throughout the industrialized world to attempt to attract high technology industry. The availability of venture capital in Alberta could give the Province an early advantage in the case of embryonic industries.

(d) An examination of the U.S. microelectronics industry indicated that currently there is a significant shortage of venture capital available to new companies in that industry. This could represent a significant opportunity, if Alberta chose to attract high technology development in this field.

(e) A supply of venture capital provides the opportunity to mobilize new ideas at their inception, instead of relying on costly incentives, directed at attracting industries once they have developed in other areas.

(f) Venture capital is a form of government investment which, in the event of success, can be readily transferred to private ownership, to the ultimate benefit of both the public and private sectors.

(g) A very small proportion of Alberta's financial resources can have a major long-term impact on the Provincial economy because of the leverage provided by using the venture capital system in the manner contemplated.

Why Will Dependence On Private Sector Venture Capital Companies Not Be Effective?

- Dependence on private sector venture capital companies will not be effective because:

  (a) Almost all Canadian venture capital companies are too small to be effective, consistent suppliers of venture capital at all stages of need.

  (b) Few can handle situations requiring even one million dollars of start-up capital, often a threshold level for significant innovation.

  (c) Few are of sufficient size to possess the diversified investment portfolios which enable participation in the high potential (high risk) opportunities at an acceptable level of risk to their overall portfolios.

A Conceptual Framework For Alberta

- The project team has concluded that private sector venture capital companies will not be capable of assembling the pool of venture capital required to attract a significant innovation process to the Province.

- Various approaches for Government funding of new ventures have been tried in other countries and it is suggested that the Government examine those that have been successful.

- A conceptual framework for the development of a major venture capital system in Alberta is discussed in detail in Chapter VII of Volume III and the interested reader is referred to that Chapter and to schematic diagram, Figure VII-2. The structure would attempt to achieve three main objectives:

  (a) to utilize part of the Heritage Trust Fund to stimulate the process of technological innovation within Alberta;

  (b) to create a mechanism whereby the ownership of successful ventures could be transferred to the private sector - particularly to Albertans, whose funds gave rise to such success; and,

  (c) to respond to the political realities associated with the commitment of public funds to direct support of the private sector, in a way which involves equity participation and risk.

- The suggested structure has the following generation characteristics:

  (a) It permits Government involvement on the major scale needed.

(b) It limits risk of financial loss to the interest generated by the capital funds provided.

(c) The Government is insulated from operation of the system such that, on the one hand, entrepreneurs need not fear direct political intervention and, on the other, the Government cannot reasonably be held responsible for entrepreneurial failure.

(d) The funds available would have the magnitude to attract entrepreneurs to Alberta from the world-wide scientific and technical community.

(e) The system provides an option whereby, if it was desired, mature, successful new ventures could be sold to a vehicle in the private sector in which Albertans and other Canadians could participate.

B. SPECIFIC INDUSTRIES WITH DEVELOPMENT POTENTIAL

1. THE PHARMACEUTICAL INDUSTRY

- The pharmaceutical industry was selected as one with potential for significant development in Alberta, because of the following positive aspects:

(a) the pharmaceutical industry has a good growth record over the past decade and substantial continuing future growth is projected;

(b) with a few exceptions the industry environmentally is relatively clean and provides good quality jobs;

(c) pharmaceuticals are one of the high technology industries, very dependent on major research activites.

Extensive pharmaceutical research efforts in Alberta appear compatible with and complementary to projected major medical research efforts and could also lead to related research in "genetic engineering". With research undertakings in all areas being additive in creating a major, overall research community or "critical mass", pharmaceutical research would be a welcome addition to the establishment of a research-oriented climate in Alberta;

(d) pharmaceutical products, in general, are of high value relative to weight and bulk and therefore can be transported significant distances without major economic penalty;

(e) Canada produces only a small fraction of its pharmaceutical needs and therefore a significant Alberta industry would have direct access to a not insignificant market;

(f) the industry is more "recession proof" than many;

(g) from a national point of view, and therefore important as an Alberta contribution to Canada, a strong pharmaceutical industry provides a number of social, economic and political benefits. It improves the balance of payments, provides tax revenue, is a technological asset, reduces dependency on foreign pharmaceutical sources and plays a significant role in communicating new medical standards to practitioners.

Description Of The Industry

General

- The pharmaceutical industry is a complex one involving an extensive heterogeneous range of industrial and trade activities. While the proprietary drug sector of the industry is important, it is dwarfed by ethical drugs (promoted only to professionals) which in many major developed countries account for about four-fifths of industry sales.

- Globally, antibiotics, vitamins and analgesics are the three major drug classes. An enormous number of products exist - it is estimated there are as many as 250,000 in the United States, with the typical general practitioner using only 50.

Size and Growth

- The industry is enormous, with 1975 global sales at manufacturers prices at $37,500 million and projected to reach $100,000 million by 1985.

- During the decade ended in 1975, the global compound annual sales growth was estimated at 11 per cent, with a similar growth rate projected for the ten year period ended in 1985.

- The United States, Western Europe and Japan account for an estimated 75 per cent of world demand. Developed nations spend from six to eight per cent of their Gross National Product on health care, with pharmaceuticals making up 15 to 22 per cent of that sum. Developing nations spend a much lower portion of GNP on health care, but a higher percentage of health care costs are in pharmaceuticals. The world average per capita expenditure on pharmaceuticals in 1975 was $9.60.

Industry Structure And Characteristics

- Globally there are 10,000 pharmaceutical manufacturers, with perhaps 2,000 to 3,000 broadly competent and 100 of these supplying 90 per cent of world shipments. In 1974, 14 companies had pharmaceutical sales of in excess of $500 million. The United States, Western Europe and Japan have a dominant position in world pharmaceutical production.

- All major pharmaceutical manufacturers are diversified and only about half derive more than 50 per cent of revenues from pharmaceuticals. Similarly, all the major producers have operations in many countries.

- Most countries are dependent on outside sources for pharmaceuticals, with less than ten countries in the non-communist world supplying more than 50 per cent of their national needs. Canadian firms provide about 15 per cent of Canada's pharmaceutical demand.

Research

- Strong research capability is the foundation for both corporate survival and exceptional success in the pharmaceutical industry. Successful organizations have very extensive, carefully planned research programs.

- Research and development is costly, with some leading producers now spending 13 to 15 per cent of sales in this area.

Risk

- It is estimated that the current, pre-tax profits of the average major U.S. based pharmaceutical company is 25 per cent of sales. This relatively attractive return is accompanied by what is generally regarded as relatively high risk. The risk element encompasses such things as the major costs ($50 to $75 million) to establish a genuinely new product, the lengthy time frame for new product development, difficulty in obtaining necessary approvals,the need to market through a very sophisticated medium (the physicans), dangers of errors in manufacturing and labelling products and the potential of liability suits from drug side effects.

Government And The Industry

- The pharmaceutical industry is subject to close governmental scrutiny in almost all areas of industry activity.

- Through regulatory and licensing agencies, governments have a major influence on drug research, product quality control, information, pricing, distribution, assortment, selection and availability of products. In the future, government involvement in the regulatory process is likely to increase.

- State ownership of pharmaceutical concerns is very limited and the private sector has the ownership field almost exclusively to itself because governments cannot cope with the "pricing dilemma".

The Pharmaceutical Industry In Canada And Alberta

- In 1977, 127 Canadian pharmaceutical establishments employed 14,231 and shipped goods with a value of $158 million. This industry output is less than that of the larger, individual U.S. manufacturers.

- The Canadian industry is concentrated in Ontario and Quebec, with those two Provinces having 90 per cent of Canadian establishments and accounting for 98 per cent of Canadian goods shipped. The industry produces less than 20 per cent of Canada's needs.

- In 1977, Alberta had one pharmaceutical company.

- Canadian pharmaceutical certification is accepted throughout the world. However, the regulatory climate is regarded by some concerns as overly restrictive.

Observations On The Industry And Its Trends

- Informed observers have concluded that some of the directional changes likely to occur within this dynamic, high technology industry will be as follows:

  (a) pressures from governments, consumers and other sources are resulting in an increasingly controlled environment in which pharmaceutical companies must operate;

  (b) pressures are forcing foreign based multinationals to make increased contributions to the welfare of the countries in which they operate. These contributions take the form of more major research and basic production, and better dialogue with health care professionals and academics;

  (c) throughout the world there are growing demands for better health care. Many developing countries now have very modest programs;

  (d) rising total health care costs may lead to greater use of pharmaceuticals. Patients/consumers are participating more in self-treatment, with freer access to drugs;

  (e) because it is the single largest market in the world, one of the premier centres for pharmaceutical research and a country with virtually no public pricing schemes, it is becoming increasingly mandatory for all major international companies to have a strong presence in the United States;

(f) it is expected that Japanese and European companies will obtain an increasing share of the world market, in large part at the expense of U.S. concerns.

(g) there is a trend towards an increase in the number of large companies and disappearance of small and medium concerns (through mergers, acquisitions, etcetera) as international scale research, production and marketing impacts on the economics of the smaller companies;

(h) because of the large sales volumes achieved by the industry and strong projected growth rates, major companies in businesses related to pharmaceuticals are finding the pharmaceutical industry to be an increasingly attractive one;

(i) although recent years have not produced a high level of new products, it is expected that a revival of the innovative period of the 1950s is imminent;

(j) the industry is capital intensive with new product development costs frequently in the area of $50 to $75 million and large scale facilities involving capital expenditures of perhaps $300 million.

(i) the building of a major new pharmaceutical company from internal growth appears unfeasible because of competitive and regulatory factors.

The Potential For Pharmaceutical Industry Development In Alberta

- Alberta's current pharmaceutical industry is virtually non-existent, indicating that the combination of necessary conditions for significant operation does not exist at present.

- Of importance to a potential Alberta manufactuer, is the fact that the Canadian industry currently supplies less than 20 per cent of demand and, therefore, a significant part of the national market could be available.

- Of major interest to a potential Alberta manufacturer is the proximity of the United States which has the world's largest pharmaceutical market, shares a common language with Canada, enjoys generally friendly relationships and is supplied through similar pharmaceutical distribution patterns.

- Research is key to pharmaceutical success. An attractive research climate and significant total research activities in Alberta, while not currently in existence but potentially possible, would contribute to an attractive environment for the pharmaceutical industry.

- While some disadvantage in transportation costs and tariffs would affect an Alberta producer serving the U.S. market, neither is considered to be a major impediment.

- Many countries are wooing pharmaceutical manufacture with financial, tax and other incentives. If Alberta is to compete successfully in attracting new industry of significant proportion, it will have to meet or better the perceived total benefits of alternative locations.

- It is expected that in coming years both Japanese and European pharmaceutical producers will greatly increase their presence in the large U.S. market. Alberta may be an attractive base from which to launch such a campaign, under the right conditions.

- There appear to be a number of reasons why Japanese pharmaceutical firms will make a move into the U.S. market, including:

(a) Japanese firms in Japan are "under attack" by foreign entrants;

(b) the Japanese have failed to develop other major Asian markets;

(c) currently the Japanese presence in the U.S. market is very modest;

(d) current exchange rates are an incentive for direct Japanese involvement in North American markets;

(e) the Japanese industry has developed a reputation for innovative capability in new pharmaceuticals;

(f) Japanese producers are facing increasing domestic pricing regulatory pressures;

(g) Japanese firms have significant financial muscle and could undertake major international expansion.

- Many of the factors indicating a move by Japanese firms into direct North American market participation, also apply to European companies. On balance, it is felt that Japanese firms provide the most likely source of new involvement in Alberta.

2. THE TELECOMMUNCATIONS INDUSTRY (EQUIPMENT MANUFACTURE)

- Telecommunications is the means by which electric or electromagnetic signials are used to transmit information between or among points. Transmission media may be radio, light or waves in other portions of the electromagnetic spectrum, wire, cable, glass or any other medium. The industry is a highly technical, rapidly changing one.

- The telecommunications equipment manufacturing industry, which supplies the telecommunications industry with its very major and complex equipment needs, is represented in Alberta. Preliminary analysis indicates the equipment manufacturing industry has potential for major growth and has the following appealing factors:

  (a) the industry is large, has been growing rapidly and, over the next decade, is expected to enjoy continued rapid growth throughout the world;

  (b) environmentally, the industry is relatively clean and provides good quality jobs;

  (c) the telecommunications equipment industry is a high technology, research oriented business and as such appears appropriate for Alberta;

  (d) Alberta is not located in close proximity to major telecommunications equipment markets. However, the high value of the equipment, relative to weight and bulk, permit transportation without significant cost impediments.

- In order to analyze telecommunications equipment manufacture, some discussion of the telecommunications industry itself is essential and that summarized discussion follows.

Description of the Telecommunications Industry

- The global telecommunications industry consists of a complex hierarchy of local, regional, national, international and inter-continental transmission, switching and signalling systems that interconnect terminals such as telephone sets, data terminals and teletype machines.

- In most countries telecommunications facilities and services are both monopoly owned and operated by governments. In the United States and Canada government licensed common carriers provide much of the total service, with the Bell System playing a major role in both countries.

- International telecommunications are handled through a complex system of corporate and government structures using overseas transmission media such as cable, satellite and radio.

- In Canada and the United States the major telecommunications operating organizations are the telephone companies, common carriers (firms providing services under regulations requiring reasonable access for all potential customers) and record carriers (common carriers providing services with output in printed or printable form).

Description Of The Major Telecommunications Equipment Manufacturing Firms And Markets

- The three principal functional areas of, and markets for, telecommunications equipment are:

  Terminals - devices used to interface persons and machines to the telecommunications network.

  Transmission - equipment and systems that form the paths or channels within which information is transferred electronically.

  Switching - the equipment and systems that perform the function of connecting terminals and of controlling routing and scheduling the flow of information over transmission links.

- Telecommunications equipment manufacture is shared among a relatively small number of very large firms in North America, Europe and Japan. Six of the top ten manufacturers each has annual sales in excess of one billion dollars.

Future Directions of Telecommunications And Equipment Manufacturing

- Telecommunications is expected to be one of the biggest and most pervasive of all industries.

- Over the past 50 years tremendous technological advances have been made in telecommunications. Currently, great technical advances are also being made in the information industry and it is expected that there will be a move toward a single system combining telecommunications and information. The electronics revolution will play a major part in new developments in this industry. The computer and integrated circuit industries will be very prominent.

- It is estimated that the total world market for telecommunications equipment during the 1980s will approach $390 billion. In excess of 90 per cent of this market is in North America, Europe and Asia.

- Switching, transmission, and terminals, the three major components of telecommunications equipment are all expected to show major growth over the next decade.

- Other significant telecommunications equipment markets are mobile telecommunications, fiber optics, cable television and business communications.

New Technologies and Telecommunications Trends

- A large number of new telecommunications applications are emerging, Most of these are presently aimed at the business market, with similar applications for the residential market expected to be introduced over the next few years. These new applications include electronic mail systems, offices "of the future", computer message services, communicating word processors, teleconferencing, special purpose systems, electronic private branch exchanges, distributed data processing and transaction systems, distributed computing systems, multipurpose digital systems and interpremise and intrapremise multipurpose communication systems.

The Potential For Telecommunications Equipment Manufacture In Alberta

- The telecommunications equipment manufacturing industry appears, on balance, to be an attractive one for Alberta. It already has some representation here.

- Although Alberta is not located in a major market, the cost of transporting to markets high value - low weight products should not be a major competitive disadvantage.

- In order to attract major industry participation, the components of an attractive environment are essential and some of these are not now in place in Alberta.

3. THE MICROELECTRONICS INDUSTRY (SEMICONDUCTORS)

Description of the Industry

General

- The origins of the semiconductor industry began in the United States in 1947, with the development of the transistor, a small, low power, amplifier, which replaced large, power intensive vacuum tubes in a wide array of electronic equipment.

- Subsequent to 1948 a rapid evolution of industry technology has occured, such that today's very large scale integrated circuits contain over 100,000 transistors on a silicon chip the size of a finger nail.

- The ever increasing miniaturization of semiconductors has resulted in them becoming an integral part of a vast array of electronic equipment with continued rapid growth in demand anticipated.

- The principal products produced by the large scale integrated circuit segment of the semiconductor industry are semiconductor memories for computers, microprocessors (small, elementary computers on a single silicon chip) used in a variety of applications, and dedicated functional circuits (for volume, custom applications such as calculators, watches and musical instruments).

Industry Structure And Characteristics

- Until the mid-1960s large American, Japanese and European companies dominated the industry. Rapid technological changes and entrepreneurial opportunities resulted in the dominant position of the majors being shared today with many new entrants.

- Because of the continuous and rapid technological changes occurring in the industry, research and development is of utmost importance, with leading producers spending ten per cent of sales revenue on research and development.

- The United States has been and continues to be the world leader in the industry (the U.S. accounted for 85 per cent of large scale integrated circuit production in 1974). However both Japanese and European companies are now making substantial inroads into the U.S. position.

Size, Growth And Profitability

- The 1979 world market for semiconductor components was estimated at $10 billion and a real growth rate of 14 per cent per year is forecast for the 1980s.

- With the exceptional large scale integrated circuits in many new uses, the heavy dependence on computer and business equipment has declined. In addition to the traditional market, consumer hardgoods, instruments, telecommunications equipment and industrial control equipment markets have become significant.

- The growth of some U.S. semiconductor companies has been extremely rapid with successful primary producers such as Intel, National Semiconductor and Mostek more than tripling sales over the past five years. Return on equity of many industry companies has been substantial, with the three firms just mentioned, earning from 15 to 31 per cent in 1978 and 1979.

Principal Strategic Factors Affecting Development Of The Industry

- Based on U.S. experience, one of the reasons for the exceptional development of microelectronics there, was the substantial and broadly based support received from various U.S. government agencies.

- The synergy which developed in the U.S. between the computer and semiconductor industry created an environment in which both industries expanded with spectacular growth rates.

- Innovation has been and, for the foreseeable future, will remain a major factor in the growth of the semiconductor industry.

- Access to large markets for semiconductor output is essential to success of the industry.

- In Europe and Japan the bulk of current semiconductor capability is within large, vertically integrated companies. In the U.S., with a few exceptions, semiconductor capability resides in companies where this activity represents a major part of total company activity. Many analysts believe the U.S. structure has resulted in rapid diffusion of technology and the ability for progressive companies to react swiftly to new product developments and market opportunities.

- The semiconductor industry is very dependent on skilled management and labour resources. In the U.S., the fortuitous combination of high personnel mobility and the existence of several major research centres, has resulted in the development of skill clusters in the areas where semiconductor activity is concentrated.

Future Trends And Issues Facing The Industry

- The industry currently is unable to meet the demand for its products and expansion of facilities is being hampered by the rapidly escalating cost of constructing the increasingly complex plants.

- Some analysts believe the industry is not earning sufficient profit to finance it's phenomenal growth and that greater levels of investment are considered necessary.

- The increasing use of large scale integrated circuits by large manufacturers such as IBM, ITT and the automobile makers has resulted in much more captive production, at the expense of merchant suppliers.

- In order to maximize value added, there is a trend toward forward integration by semiconductor manufacturers.

- Skilled production personnel shortages are a fundamental problem at present and the industry is attempting to develop less labour intensive manufacturing procedures.

- There is a continuing wave of enthusiasm for takeovers of smaller independent semi-conductor firms both from within and from outside the industry.

Alberta Participation In The Microelectronics Industry

- The industry is virtually non-existent in Alberta and has a small presence in Canada.

- The general characteristics of the industry, its high value added relative to weight of products, its highly skilled labour force requirements and its long-term growth prospects, make it a desirable industry.

- Before significant activity in microelectronics can occur, much will have to be done to develop the infrastructure, the incentives and the general knowledge and technology intensive environment.